

DEPARTMENT OF THE INTERIOR

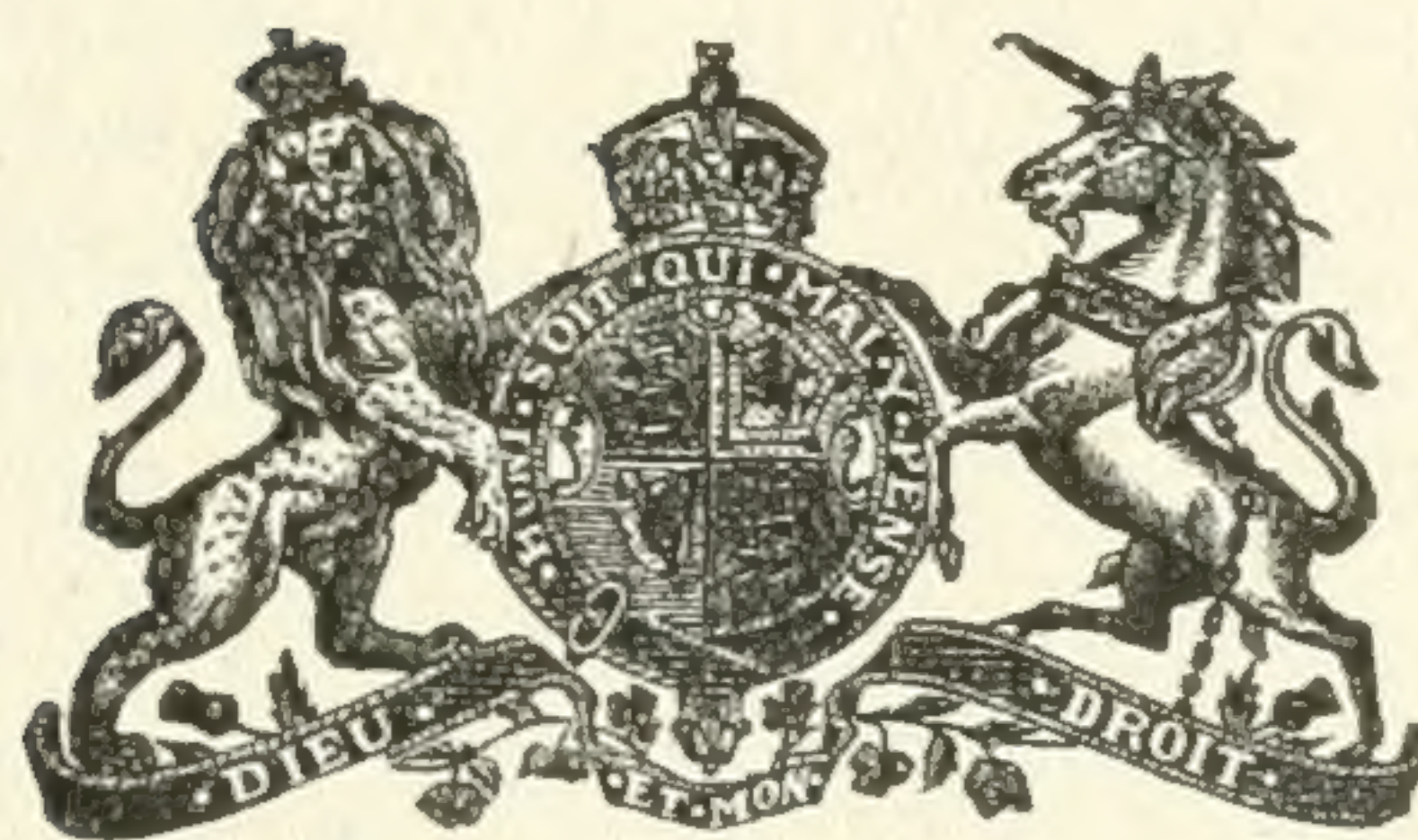
ANNUAL REPORT

OF THE

TOPOGRAPHICAL SURVEYS
BRANCH

1915-16

PRINTED BY ORDER OF PARLIAMENT.



OTTAWA

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PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1917

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2. Map showing topography and profiles of base lines and meridians run during the year.

REPORT

OF THE

SURVEYOR GENERAL OF DOMINION LANDS

The amount appropriated by Parliament for Dominion Lands surveys during the fiscal year 1915-16 was \$1,043,500, practically equivalent to the appropriation of the previous year.

INITIAL MERIDIANS AND BASE LINES.

The initial meridians and the base lines, which are the governing lines of the whole system of Dominion Lands surveys, have been established so far beyond settlement that their further extension has ceased to be very urgent, and the number of parties engaged on that work could be reduced to six. They surveyed 962 miles.

A record was made in producing the Sixth meridian two miles into township 127, which is also two miles beyond the northern boundary of Alberta, the farthest point north reached by the Dominion Lands system. This brings Dominion Lands surveys 763 miles north of the international boundary. In the other direction, they stretch in an unbroken network from tide water on Hudson bay at Port Nelson to tide water on the Pacific at Burrard inlet and Semiamu bay, nearly 1,400 miles.

Although far north, good farming country was found on the Sixth meridian. Keg River trading post is in the centre of a beautiful prairie consisting of several townships of good agricultural country. Good stretches exist also along Battle river. North of township 120 are the Cut Knife mountains, the soil of which, under its coating of deep moss and stunted spruce, remains frozen throughout the summer.

Good country was found on the Wabiskaw between Peace river and the Fifth meridian, but it is difficult of access at present.

East of lake Winnipegosis and south of Saskatchewan river is a stretch which the surveyor describes as the finest agricultural land he has seen in northern Manitoba.

Elsewhere, the surveys of base lines and meridians have not disclosed much land of value. The country has been explored for twelve miles on each side of the line surveyed and the information obtained is shown on the exploration maps appended to this report.

TOWNSHIP SUBDIVISION.

The regular township subdivision surveys have hitherto been performed under contract, at certain rates per mile fixed from time to time by the Governor in Council. The method has proved most unsatisfactory.

In 1913 it was recommended that the contract method be abandoned and that in future the subdivision of townships be executed by surveyors and parties paid by the day. The arguments in support of this recommendation were as follows:—

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1. The system of Dominion Lands surveys is an adaption of the United States system. The method of surveying under contract was one of the features borrowed from the United States; it had several advantages, and as land had little value, it was believed that the imperfection of the surveys was of small consequence. The system was cheap, and as little or no inspection was made, it gave no trouble for the time being. Surveyors were ready to undertake surveys for almost any remuneration. At one time, tenders were called: the rates asked by the surveyors were so absurdly low that they have since been fixed by Order in Council at a figure sufficient for doing the work irrespective of what the surveyors would be ready to accept. A consideration which had great weight when a rush of immigration set in was that the amount of surveying which could be performed under the contract system was unlimited. With work paid by the day, the amount was limited by the number of qualified surveyors available: there was no such limitation with contractors.

2. The objections to surveys made under contract are many. The cost of a subdivision survey cannot be estimated in advance; it depends upon the nature of the ground and upon other circumstances unknown both to the Government and to the contractor, and which cannot be foreseen. No schedule of rates can be devised which will afford fair remuneration to the contractor in all cases without being excessive in any case. A contractor may make large profits if he happens to strike good country and is favoured by circumstances, while another may lose money through no fault of his own if circumstances are against him. If he is unable to pay the wages of his men or his bills for supplies, the creditors ask payment from the Government and are aggrieved when it is refused.

3. Before a contractor is paid for a survey, some one should go over the lines in order to make sure that the survey for which payment is asked has actually been made. This inspection is never made for the obvious reason that it costs as much to inspect a survey line as to survey it in the first instance, the inspection involving the same measurements as the survey itself. If all the lines were inspected, the inspector might as well survey them himself and dispense with the survey of the contractor, thus saving the cost of the contract.

In the early days, very little inspection was made: the word of the contractor that the survey had been correctly executed was accepted and he was paid. We are now going over these old surveys; many of them are incorrect. Sometimes we can find no trace of a survey, and it is a question whether the original survey, which was paid for, was ever made.

4. At present, an inspection is made of a few miles in each contract. If nothing wrong is found, it is assumed that the remainder of the contract has been executed and that the survey is correct, but there is no direct evidence that such is the case.

5. There are five inspectors and a chief inspector of surveys; the cost of inspection is over \$68,000 a year. The expenditure on contract surveys this year is \$240,000, so that the inspection costs more than one-quarter of the work inspected. It is true that the inspectors do some little work besides inspection, but it does not amount to much.

6. Some surveyors do good work under contract; others do not. When a contractor's work is found defective, he is invited to correct it. He corrects the defects pointed out by the inspector, after which a new inspection is made and new defects are discovered. This may happen again and again until so many inspections are made that it would have been cheaper for the inspector to make a new survey.

7. When the survey is very bad, the situation is most embarrassing. The bond given by private sureties for securing the advances does not appear to have much value; we have lost the cases that were brought before the courts. Surety companies are the only ones from whom we have recovered because they prefer paying to being sued by the Government. Practically we have the alternative of accepting bad work or losing our advances.

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8. A large proportion of the appropriation for Dominion Lands surveys is now being expended in resurveying townships imperfectly subdivided under contract. The lands being settled and occupied, the resurveys are very intricate, unsatisfactory to the settlers, and most expensive. Money would have been saved if the surveys had been properly made in the first instance. For this reason alone, if for no other, the contract system should be abolished.

9. Land has become too valuable for the imperfections of the contract system. The value of one or two acres in a quarter-section represents many times the difference in cost between a good and a bad survey.

10. After he has finished the survey in the field and received 75 per cent of the amount of the contract, the contractor attends to the preparation and correction of his field notes when he is not otherwise engaged. This is the cause of serious delays: it is seldom less than two years before the township plans are issued and the lands thrown open to settlers.

11. With competent surveyors and properly organized parties, there is no reason why subdivision surveys paid for by the day should cost much more than if executed under contract.

12. The contract system was discarded in 1910 by the United States. The last report of the Commissioner of the General Land Office contains the following remarks:

"June 30, 1911, was the close of the first fiscal year under the direct system, and it is gratifying to be able to report that it has been an unqualified success. When the change in method from the contract to the direct system was first considered, it was expected that the cost of production would not be greater than that in the procedure which it was proposed to abandon. It was conceded that greater expedition would ensue and better work be accomplished, and this alone would have justified the change. The work of last season and this season, however, has shown that the average cost of survey of a township under the direct system is \$750, or a saving of about \$5 per mile, the average cost of surveys under the contract system being \$15 per mile.

. . . . There is, in addition, a saving of from one to two years in time, counting from the time of the appropriation to the completion and adoption of the survey."

Before finally adopting the recommendation to perform subdivision by day work, it was decided to give the new method a trial. This was done with one party in 1914, and the experiment proved so encouraging that the method was adopted for all regular subdivision surveys in 1915. The result has been an unqualified success. The work accomplished and net cost per mile, which are given below, are obtained by deducting from the total expenditure of each surveyor the value of the outfit remaining on hand at the end of the season. Four of the surveyors took levels, which was not done under the contract method; the cost of the levels was also deducted from the total expenditure.

REGULAR TOWNSHIP SUBDIVISION—1915.

Surveyor.	Miles.	Total expend- iture.	Value of outfit.	Cost of levels.	Net cost.	Cost per mile.
		\$	\$	\$	\$	\$ cts.
Baker, J. C.....	471	16,170	469	.....	15,701	33 33
Buchanan, J. A.....	412	14,816	606	.....	14,210	34 49
Christie, W.....	454	10,759	352	765	9,642	21 23
Davies, T. A.....	345	14,237	952	.....	13,285	38 50
Day, H. S.....	344	14,850	349	.....	14,501	42 15
Fawcett, S. D.....	409	15,377	889	.....	14,488	35 42
Glover, A. E.....	404	14,906	480	.....	14,426	35 70
Heathcott, R. V.....	455	14,993	690	.....	14,303	31 43
Johnston, J. H.....	460	14,789	300	885	13,604	29 57
Knight, R. H.....	381	14,965	696	.....	14,269	37 45
Lighthall, A.....	511	14,766	875	945	12,946	25 33
McEwen, D. F.....	562	13,937	542	.....	13,395	23 83
Pearson, H. E.....	502	13,757	479	.....	13,278	26 45
Pierce, J. W.....	628	17,419	788	.....	16,631	26 48
Rolfson, O.....	558	13,399	325	.....	13,074	23 43
Scott, W. A.....	470	14,286	398	790	13,098	27 87
Tipper, G. A.....	375	15,116	659	.....	14,457	38 55
Tyrrell, J. W.....	423	10,946	362	.....	10,584	25 02
Waddell, W. H.....	448	*15,000	300	.....	14,700	32 81
	8,612	274,488	10,511	3,385	260,592	30 26

*Estimate only—Accounts and returns not in yet.

The comparison between subdivision under contract in 1914 and subdivision by day work in 1915, is given below:—

Year.	Method.	No. of parties.	Miles surveyed.	Total cost.	Cost per mile.
1914.....	Contract....	18	7,686	\$ 229,303	\$ 29 83
1915.....	Day Work..	19	8,612	260,592	30 26

The cost per mile of day work is 43 cents more than contract work, less than one and a half per cent, but an examination of the table for 1915 shows that the average cost of day work is considerably increased by the high individual cost of three surveyors. By placing in charge of subdivision surveys those surveyors only who have made a success of this kind of work, as has been done in 1916, the cost will be substantially less than under contract. It must be recognized, however, that day work is possible only so long as surveyors are left free to select and engage their own labour, without any interference. The advantage of the surveyor on salary over the contractor is that he has better credit. His men know that their wages will be paid when due, and a merchant, if not paid cash, knows that he has not long to wait for his money. It is not so with contractors; when they do not fail, leaving their creditors unpaid, they are generally slow in paying, and are accordingly charged higher rates.

At the inception of Dominion Lands surveys, a road 99 feet wide was laid out on every section line, and marked on the ground by the surveyor. This is what is called the first system of survey. Later, the width of the roads was reduced to 66 feet, and every alternate road running east and west was suppressed. This is the third system

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of survey, which extends over the greater part of the country. In subdividing a township of the third system, the surveyor marked only those section lines along which were the roads, the section lines without roads, the "blind lines," remaining unsurveyed. This is a great handicap to the new settler: to find the limits of his quarter-section, he has first to locate the quarter-section corner on the blind line, and this, especially in wooded country, is more than an ordinary farmer can manage. The procedure has now been changed, and in subdividing a township all section lines are surveyed and marked on the ground, whether the township is of the first or of any other system. The change is one which will be thoroughly appreciated by new settlers.

TOWNSHIPS SUBDIVIDED.

Most of the townships subdivided are in the Peace River district. The construction of railways to Spirit River and Peace River Crossing has made the country easily accessible, and turned the flow of new settlers in that direction. The survey parties were spread along Peace river from Fort St. John in British Columbia, to below Fort Vermilion. Others were south and east of Lesser Slave lake and on Athabaska river below McMurray. The land immediately adjoining the Alberta and Great Waterways railway between Lac La Biche and McMurray was laid out into sections. Although little of it is adapted to farming, some pieces will be taken up and the railway itself will require grants.

In addition to the nineteen parties engaged on regular subdivision work, twelve parties were employed on miscellaneous and scattered subdivision at various points in Manitoba, Saskatchewan, and Alberta. Seven parties were working in the railway belt of British Columbia. In the western part of the belt, the land, which is very valuable, is disposed of in quarter quarter-sections, or legal subdivisions, of forty acres, the corners of which have to be marked by boundary monuments. This not only increases the work on the survey line but also the number of lines to be surveyed, and with the heavy timber contributes to make the surveys in that section of the country exceedingly expensive.

INSPECTION.

The system of inspection has been modified to adjust it to the new conditions of subdivision surveys. The camps of most surveyors were visited, the work examined, and a report made upon the organization and equipment of the parties. Three inspectors were employed on this work, and in addition the Chief Inspector of Surveys spent five weeks in the field.

When not otherwise engaged, the inspectors occupy their time on miscellaneous surveys.

WATER AREAS.

Many of the bodies of water which existed at the time of the original survey have since partially or wholly dried up, leaving their beds available for cultivation. Twelve parties were employed in making a new survey of these areas. The surveyor's instructions are to make a thorough investigation of each township, to survey every body of water found in it and to obtain all the information necessary for the preparation of new township plans representing actual conditions. He is also directed to report upon the condition of the boundary monuments in the township, and any other feature of the township survey. Occasionally he may, where necessary, erect or restore a few boundary monuments, but his party being small, work of this nature is preferably allotted to larger parties.

The twelve parties investigated 734 townships. They surveyed 5,007 miles for the water areas, and resurveyed 762 of section lines. The table below gives a synopsis of their work.

STADIA SURVEYS.

Surveyor.	Water areas miles.	Re- survey miles.	Total mile- age.	No. of town- ships.	No. of lakes.	Total cost.	Cost per mile.	Cost per town- ship.	Cost per lake.
						\$	\$ cts.	\$ cts.	\$ cts.
McKnight, J. H.....	577	8	585	31	216	5,479	9 37	176 74	25 37
Boulton, W. J.....	564	12	576	39	134	5,067	8 79	129 92	37 80
Neelands, R.....	526	129	655	50	263	5,116	7 80	102 32	19 45
Soars, H. M. R.....	523	2	525	45	276	5,387	10 26	119 71	19 52
Fletcher, W. A.....	484	62	546	27	349	4,946	9 05	183 18	14 17
Martindale, E. S.....	{294}	20	469	{59	147	3,618}	12 02	67 12	24 51
Coltham, G. W.....	{155}			{25	83	2,020}			
Cowper, G. C.....	294	84	378	81	87	5,313	14 06	65 59	61 07
Bowman, E. P.....	440	34	474	54	238	5,695	12 02	105 46	23 93
Roberts, O. B.....	390	92	482	76	183	5,642	11 70	74 24	30 83
Bennett, G. A.....	340	131	471	75	176	5,514	11 71	73 52	31 33
Palmer, P. E.....	238	75	313	64	244	5,193	16 59	81 14	21 28
Rinfret, C.....	182	113	295	108	125	4,642	15 73	42 98	37 14
	5,007	762	5,769	734	2,521	63,632	11 03	86 69	25 24

ALBERTA-BRITISH COLUMBIA BOUNDARY.

From the international boundary to the 120th degree of longitude, the boundary between British Columbia and Alberta is the continental divide. The location of this boundary, commenced in 1913, was continued. The two provinces and the Dominion pay each one-third of the cost. R. W. Cautley, D.L.S. and A.L.S., is commissioner for the Dominion and Alberta. A. O. Wheeler, B.C.L.S., is commissioner for British Columbia. Mr. Cautley locates and marks the boundary in the passes; Mr. Wheeler makes a topographical survey of the boundary in and between the passes. About twelve miles of line was delimited in the passes and twenty-six boundary monuments erected. All work so far has been south of the Kicking Horse pass, the passes marked last season being the Akamina, Elk, Dome, and North Fork.

TOPOGRAPHICAL SURVEY.

With the exception of Mr. Wheeler's survey of the interprovincial boundary, the only topographical work was a survey of Jasper park. The season was not favourable; of 114 days, only 48 were fine, and even then the work was often retarded by haze or cloud shadows.

SETTLEMENTS AND TOWNSITES.

A number of small settlements and townsites, principally in Manitoba, were surveyed. River lots were laid out on Carrot river, and at Grand Rapids on Saskatchewan river in Manitoba. The St. Julien addition to the townsite of Banff was surveyed on Tunnel mountain.

TIMBER BERTHS AND MINERAL CLAIMS.

Two timber berths with eleven miles of boundaries were surveyed. Every mineral claim is designated by a lot number in the group to which it belongs. Before the issue of the patent for the claim, the regulations require a survey under instructions of the Surveyor General. Twenty-nine of these claims were surveyed.

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YUKON SURVEYS.

The Surveyor General is represented in the Yukon Territory by a Director of Surveys, assisted by one draughtsman. According to the director's report, which is appended, the returns of fourteen surveys were filed in his office. These consisted of Indian reserves, road traverses, and surveys in connection with mining claims.

RESURVEYS.

The evils of the slovenly surveys executed under the contract system in the early days are coming home now that the land is being settled. They are of two kinds; inaccuracy of the survey and lack of permanency of the boundary monuments. At that time land had little value, and any kind of survey was considered good enough. Inaccuracy is obnoxious, but the greatest trouble is caused by the loss of boundary monuments. At first wooden posts were used, as they had been in the eastern provinces, but the conditions were quite different. In the East these posts were made of durable wood, and the lines blazed in timber remained visible for a long time; in the West the posts were of poplar, a kind of wood which decays quickly, and where lines were blazed in the woods, the timber was so light that a single fire obliterated it. In the eighties, a piece of small gas pipe was substituted in the place of the wooden post, but it was easily pulled out and many have disappeared.

A new style of post has now been adopted. It consists of a one-inch iron pipe thirty inches long and filled with concrete. A malleable iron foot-plate prevents the removal of the post after it has been planted. The numbers of the section, township, and range are stamped in plain figures on a bronze cap, and the inscription can be understood by anybody. The adoption of this new post is the most important step that has yet been taken for the improvement of the surveys of the Dominion Lands. The two principal needs of a land owner are the security of his title and the security of his boundaries. His title is looked after by the Lands Titles Offices. The security of his boundaries depends upon the permanency of the boundary monuments; so long as they are in evidence, there is no room for dispute between himself and his neighbours.

To a person not conversant with surveying, the loss of a boundary monument may appear to be a matter of no great consequence, involving nothing more than the erection of a new monument, but that is very far from being the case. If the land is settled, vested rights intervene, and it is only in sparsely settled places that after a great deal of trouble, new monuments can be erected to which no one will object. In townships where any considerable proportion of the land is patented, any attempt to resurvey the lines is almost sure to prove a failure, and the only course open to the owners is to bring their disputes before the courts for adjudication.

Another source of trouble is the existence of several monuments to mark one corner; sometimes, but not always, the difficulty can be adjusted.

The Dominion Lands Surveys Act authorizes the Minister to have a resurvey made of a township on receipt of a petition stating that the monuments have disappeared and cannot be found. The same provision has been enacted as a provincial statute by the legislatures of Saskatchewan and Alberta, but not by Manitoba. Under this arrangement, it has been found possible to make resurveys which will hold good in law, in townships where the amount of lands alienated is small. Of course, the work is very expensive.

Five parties were engaged on this work. They resurveyed wholly or partially thirty-five townships and the settlement of Lac la Biche. In addition, small resurveys were made at a number of places by the same surveyors.

Errors in surveys are more difficult to correct. In old times, it was contended that a farmer whose patent calls for 160 acres, but whose quarter-section contains only 120, is just as contented as if he had 160 acres so long as he is not made aware of the shortage. In the first Dominion Lands Act, the contents of a quarter-section were

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declared to be 160 acres, whatever the actual contents might be. There may be some merit in this view when the discrepancy is small, but when it is large there cannot be two opinioins as to the duty of the administration to correct the error, if it can be done. The difficulty is that when a man has a grant from the Crown, no one has the right to displace his boundaries, whether they are in error or not. Three surveyors were engaged in work of that nature, and in adjusting difficulties of all kinds. They visited about eighty townships in all. Sometimes they were successful and sometimes they were not.

Unlike township subdivision, the initial meridians and base lines have, fortunately, for the last thirty-six years, always been surveyed with care by day work, and the result, taken as a whole, is remarkably accurate; but with the perfection of our organization and methods, we now discover discrepancies which, although individually small, assume material proportions by accumulation over the immense area covered by Dominion Lands surveys. In expanding the system, it is necessary to know the exact size and location of the discrepancies so that they may be allowed for in the expansion. For this purpose, one party retraced 677 miles of base lines and initial meridians. Advantage was taken of his survey to level the lines retraced.

Another method of adjusting the discrepancies of governing lines is by means of astronomical observations. One surveyor made determinations of the latitude with a zenith telescope at a number of points, mostly in Manitoba and Saskatchewan. Each point of observation was connected by measurement with some corner monument of the Dominion Lands system.

STATEMENT OF MILEAGE SURVEYED.

The following is a comparison of the mileage surveyed each year since 1913:—

Nature of Survey.	April 1, 1913, to March 31, 1914.	April 1, 1914, to March 31, 1915.	April 1, 1915, to March 31, 1916.
	Miles.	Miles.	Miles.
Township outlines.....	3,760	3,270	2,725
Section lines.....	7,918	7,100	7,524
Traverse.....	5,748	5,141	7,234
Resurvey.....	1,632	2,544	3,441
Total for season.....	19,058	18,055	20,924
Number of parties.....	66	59	53
Average miles per party.....	289	307	395

Owing to the nature of their work twelve parties are not included in this year's statement. The surveys of the fifty-three parties cost \$628,815, or \$30.05 per mile.

OFFICE WORK.

DIVISION OF SURVEY INSTRUCTIONS AND GENERAL INFORMATION.

The work performed by this division consists, in general, of the preparation of instructions for the surveyors who are engaged in the field operations, the entering of all survey returns in the various registers, the issuing of all preliminary plans, the answering of requests for information received from the general public and from other branches and departments, and the issuing of the annual report of the branch.

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The preparation of instructions for the surveyors in charge of parties in the field is perhaps the most important work of the division. Greater accuracy and precision in the surveys is being constantly demanded, and this necessitates more work and greater care, in the issuing of instructions as well as in the performance of the surveys and the examination of the returns. The preparation of instructions for any particular survey involves the collection of a great deal of information about the surveys which have already been made in the vicinity, the nature of the country, the roads and trails, the best means of transportation, etc. Plans and sketches must also be prepared to accompany the instructions, showing all information about the section lines already surveyed, as well as about any Indian reserves, townsites, settlements, forest reserves, etc., which are located in the townships to be surveyed.

Another important part of the work is the dealing with communications from settlers and others, and the answering of inquiries about surveys from other branches and departments. This involves the preparation of a large number of sketches, tracings and maps and the copying of many pages of field notes. As part of this work, the distribution is carried on of all the publications issued by this branch, including plans, maps, reports, and pamphlets. The number of sectional maps alone which are sent out amounts to many thousands.

As a rule the writing of descriptions for insertion in the patents for all regular parcels of land is done in the Lands Patents Branch of the department. In all cases, however, except for mineral claims, where the parcel is very irregular and the description is complicated and difficult, the description is prepared in this division.

During the period the surveyor is in the field he is required to furnish sketches from time to time showing the progress of his work. From these sketches preliminary plans of the townships are issued in order that the lands may be opened for entry at once without waiting for the examination of the surveyor's final returns and the issue of the official plans. Four copies of each plan are required for the townships in Manitoba, Saskatchewan and Alberta, and six copies each for the townships in the railway belt of British Columbia.

In this division all returns of survey are received, including plans and field notes of township, settlement, and miscellaneous surveys, of levelling operations and of the survey of timber berths, mineral claims, and rights of way. These returns are entered up in the various registers and on maps, a record being kept of the surveys performed each year by each surveyor and of the progress of each surveyor's work in the field. When the examination of the plans and field notes have been completed they are sent to the Survey Records Branch to be placed on record.

The preparation of the third edition of the pamphlet entitled "Description of the surveyed townships in the Peace River district in the provinces of Alberta and British Columbia" was commenced during the year 1914-15. The war, however, caused a decided falling-off in the number of requests for the report and, in consequence, it was decided to postpone the issue for the time. The work of preparation was again taken up during the latter part of the past year, and it is expected that the new edition will be issued in two or three months.

The topographical surveys in connection with townsite subdivision which were commenced in 1912 were again carried on during the year. Surveys were made of a subdivision known as the St. Julien addition to the town of Banff, containing an area of about 100 acres on the southwest slope of Tunnel mountain. As the plan of this area prepared last year did not show the topography in sufficient detail for laying out the subdivision further levels had to be taken and a new topographical map prepared. From this map a scheme of subdivision was laid out. Plans of the blocks on a scale of twenty feet to an inch were made and from these all the information necessary for the execution of the survey was calculated. On completion of the survey the surveyor's returns were examined and a plan of the subdivision was compiled for publication. It is expected that this plan will be issued shortly.

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A new feature of the work of the division is the examination of plans showing rights of way for irrigation ditches or works to accompany the licenses of occupation which are granted in such cases. In the past the Irrigation Branch has had difficulty in some cases in registering the licenses of occupation in the Land Titles Offices because of lack of information or errors in the plans submitted. It was with a view to obviating this difficulty that the Superintendent of Irrigation requested that the examination of these plans be undertaken by this branch. The plans are not approved, as most of them have been prepared from surveys made by the engineers of the Irrigation Branch and not by qualified surveyors. Suggestions are merely made in regard to the points in which the plans are considered defective. The various suggestions which have been offered have now been incorporated in the instructions issued by the Irrigation Branch for the preparation of right of way plans. This examination involves considerable work as some of the plans are complicated and in many cases have to be re-examined.

DIVISION OF EXAMINATION OF SURVEYS.

The work of this division comprises the examination of the returns of survey of all Dominion Lands except subdivision in the railway belt in British Columbia, together with the preparation of all official plans thereof; it includes the examination of all surveys of mineral claims, and of all plans of railways and provincial roads.

The work begins with the receipt of the field notes of survey and other final returns, and ends when these have been examined and the required corrections obtained, the official plans prepared and the final returns have been sent to the Survey Records Branch. The bulk of the field notes are received during the last four months of the fiscal year, and are dealt with during the subsequent year.

Before subdivision can be undertaken it is necessary to extend a framework of precise surveys of meridians and base lines as a control, but no official township plans are made until some subdivision has been done. The cessation of contract surveys has not greatly affected the work, as the contracts of the preceding year were on hand. This work has all been completed and the remaining twenty-nine contract accounts closed.

The first returns received from the surveyor in the field are sketches showing the progress of his work. These are examined to see that correct methods are being employed and that satisfactory results are being obtained. Nearly 1,300 of these sketches are received during the field season.

The twelve surveyors investigating former lake beds and traversing lakes in the older parts of the western provinces are required to plot their surveys as fast as they are made, and to transmit their field notes and plots without delay to this office. These are examined to ensure their accuracy; the plots are combined by tracing into larger plans, which in turn are reduced by photography for the compilation of the new township plans.

An important change was made in the preparation of plans with the result that they now show in what year and by what surveyor each monument on the plan was erected or last renewed. This information requires considerable time to secure, but greatly adds to the value of the plans.

The compilation of a township plan comprises a great many operations. First, is the proper entry of the new survey in the records of the office; then, a cursory examination of the returns; then, the records are consulted for a complete list of former surveys affecting the township. When this has been done the new survey receives its final examination, and is combined with the former surveys on the new plan. If the examination reveals errors or discrepancies in the field notes, or other defects, these must be corrected before the plan can be completed. The new survey often reveals gross errors in the old that make it impossible to complete the plan before further surveys have been made on the ground. Plans of lakes and rivers

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have to be reduced to the proper scale. A list of the lands that have been disposed of is obtained from the Patents Branch. When the plan has been compiled, the work is all carefully checked by another member of the staff, and is passed by each of two other members before being finally accepted. It is then sent to another division for copying. When this has been done it is returned for further checking of patented lands and for comparison of the copy, after which it is ready to be photo-zinco-graphed for the printing press. Plans to the number of 950 were prepared.

With regard to the maps of the Yukon Territory, considerable progress has been made in completing plans that were begun in the preceding year. Practically all the Stewart river basin to the south and east of Dawson has now been covered.

Besides the subdivision of land, the examination of surveys comprises many other important branches of work including the Alberta-British Columbia boundary, the Government inspection of surveys and surveying parties, the writing of descriptions of mineral claims for transfer to the Province of British Columbia, the examination of plans of new roads and road diversions surveyed by the western provinces across Dominion Lands and of plans of railway right of way across Dominion Lands, and the answering of requests for information concerning surveys from other branches of the department and from the general public.

DRAFTING AND PRINTING DIVISION.

Township Plans.

The preparation for printing of plans of townships still constitutes the most important work of this division, and takes up a large part of the time. The method of printing has not changed materially since the old style of coloured plans was discarded, and the present plan in black and white adopted. However, frequent minor changes have been made from time to time in the amount and character of the data shown on the plans, these changes usually being the result of changes either in the method of survey or in the manner of showing the data returned by the surveyor. The latest change of this character relates to the abbreviations describing monuments. This particular change is important to the drafting division inasmuch as it renders many of the old fair copies useless for printing new editions.

The stamping or typing of township plans is done largely by temporary men employed as required. At the outbreak of the war in August, 1914, several of these men went to the front, and from time to time others have enlisted until now five are away. The policy of the department has been to curtail expenditure and so the places of men absent from the above cause have not been filled. The results of this policy were not immediately apparent, but the work in arrears has been slowly but steadily accumulating. We have now 509 plans of townships in hand. During the year, 803 township plans have been prepared for printing.

Miscellaneous Surveys.—These plans include settlements, townsites, additions to townsites, subdivisions, mineral claims, timber berths, and plans of parcels of land for schoolsites, bridges, etc. Twenty-four such plans were prepared.

Surveyors' Sketch Maps.

The surveyors of base and meridian lines return exploratory sketches of the territory adjoining their lines. These are printed on a scale of 12.5 miles to an inch, with a profile of the line having a vertical scale of 2,000 feet to an inch. Formerly the character of the soil and vegetation was shown by verbal descriptions written on the map across the area described. An attempt is now being made to show this information by colours or by symbols, the general principle being to show

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the soil (including the state of the soil, i.e., whether wet, swampy or dry) by flat tints of colour, and to show the vegetation such as trees, grass or scrub by different symbols imposed upon the flat tints. These maps are issued with the report of the branch.

Miscellaneous Work.

Several important maps were drafted for printing. The first was a contour map of Jasper and vicinity to be printed in four sheets in four colours on a scale of 1:10,000, or 6.336 inches to a mile; the contour interval is 20 feet where slopes are steep and 10 feet in the more level portions. The map is now in the hands of the printers. The second is a somewhat similar map of the Crowsnest forest and Waterton Lakes park, Rocky Mountains forest reserve, in five sheets on a scale of 1:62,500, or 1.014 inches to a mile, with a contour interval of 100 feet. The black of both maps is engraved on copper, the other colours being printed from zinc plates made by photographing drawn copies. The second map is now in the hands of the engravers. Besides these, a number of miscellaneous jobs were done, including the preparation of plans to accompany orders in council, mounting maps and engrossing commissions and certificates for the Board of D.L.S. Examiners.

Sectional Maps.

The stock of sectional maps for distribution is in charge of this division, as the room in which they are stored is conveniently situated to the drafting room. The work consists in giving out the maps as required and in taking steps to see that the stock is reprinted before it is exhausted. As there are now 120 sectional maps printed in two weights of paper and on two scales, it requires care to see that the stock of each map is complete.

BRITISH COLUMBIA SURVEYS DIVISION.

The work of this division consists in the examination of surveyors' field notes and plots, the compilation of township, townsite, and miscellaneous plans, the comparison of the rough and fair copies of these plans and the replying to requests for various information.

Some of the field books, prepared during the last fiscal year for the use of surveyors in the railway belt, British Columbia, have been received, but at the close of the present fiscal year none of them had been examined, although a casual examination indicates that the time required will be greatly in excess of that necessary for the examination of the old field books.

The new system of compiling township plans, whereby the name of the surveyor is placed at each monument and an amended system of abbreviations used, necessitates the search of all field books appertaining to each plan, and entails, at a conservative estimate, five times the length of time for compiling that was required for the compilation of plans under the old system.

SECTIONAL MAP DIVISION.

The chief work of this division continues to be the compilation and revision of the sheets of the sectional map of western Canada. These "sectional maps," as they are briefly called, first received official mention in the Report of the Department of the Interior for 1892. The reference is on page 5 of the Report of the Surveyor General for that year, and is as follows:—

"A record of all surveys made has hitherto been kept by compiling them on a scale of six miles to one inch on diagrams printed for the purpose; they exhibit at any time the state of the surveys in any part of the country. This

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scale has been found too small for the many miscellaneous surveys executed lately, and a change has been made to two miles to one inch. From these diagrams, maps on a scale of three miles to one inch are reproduced by photolithography; the progress of settlement is shown by indicating with three different tints the lands patented, those entered, and those reserved for various purposes. Each sheet makes a map of convenient size, embracing a tract of land about fifty miles by eighty. Five have been issued; they are Edmonton, Peace Hills, Calgary, Prince Albert North, and Red Deer."

Each year since 1892 some new sheets have been compiled and printed, until now the total number is 120. These form an accurate and convenient series of maps covering the country from the lake of the Woods to the strait of Georgia and from the international boundary northward to Port Nelson and Fort Vermilion.

From the first the maps were printed on a scale of three miles to one inch and their purpose was to show in convenient form the progress of the surveys of Dominion Lands. Official surveys are still shown and may be considered to form the basis of the maps, but up-to-date information is also furnished in regard to railways and railway stations, post offices, Indian reserves, forest reserves, Dominion parks, roads and trails, road diversions, etc. Latitude and longitude are given to minutes, and altitudes are given in feet above sea-level. The maps are now printed in four colours. The sheets are numbered according to a regular system, and each sheet also has a name derived from some important city or town or from some prominent topographical feature within its boundaries.

Five new maps have been compiled covering territory recently reached by the Dominion Lands system, and twenty-three of the sheets previously issued were revised. Four others are in hand.

The work of compiling new sheets is done on printed projection forms on which township and section lines are shown in faint blue. The revision of old sheets is much facilitated by the use of white prints or photographic prints of the last edition, all changes and additions being shown thereon in red. These rough sheets when completed are checked and sent to the mapping room, where finished copies are made.

In addition to the work on sectional maps, considerable time has been spent on other work, as follows:—

(1) The township reports received from surveyors from July 1, 1914, to March 31, 1915, were prepared and printed in five pamphlets, and the reports for the year ended March 31, 1916, are well advanced.

(2) Work on the series of volumes in which it is intended to include all township reports received from surveyors from the beginning of the surveys, has been continued. Three volumes containing all reports on townships west of the Principal meridian were compiled and sent to the printer. Two of these, totalling 348 pages of printed matter, have been issued, and the third is being proof-read. One volume of reports on townships west of the Second meridian is ready for the printer, and another is in hand. Owing to the decrease in the staff, the work is not now being vigorously pushed.

(3) Sketch maps submitted by base line surveyors are now printed for the annual reports on a scale of $12\frac{1}{2}$ miles to the inch. On this scale the necessary descriptive notes take up a large part of the space and render the maps very cumbrous and confusing. It was thought that the necessary information could be better conveyed by using flat tints to represent the different kinds of soil and timber, and after several attempts a scheme of colours and symbols was decided upon for these maps by which the amount of printed notes is reduced to a minimum. Nine sketch maps were worked out on this basis and accompany this report in monograph form.

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(4) The township index map was revised. This is a map of western Canada on a scale of thirty-five miles to one inch, which is much in use in the department for showing the progress of the surveys and other information. The extension of the Dominion Lands system of surveys into the far north has given definite information as to the location of topographical features which had formerly been shown in approximate positions. Many errors were corrected, and the map was also brought up-to-date as regards railways, etc. The time of one man for a month was required in the revision.

(5) The method of obtaining the exact location of post offices and railroad stations, begun last year, has been continued. Of the 742 diagrams sent out to postmasters, 670 have been returned and the information plotted on the sectional maps.

The other work of the division is the making of clean manuscript copies, for photo-lithography, of the compiled and revised sectional maps.

Forty-six of the revised sheets and eleven new ones have been thus copied, but fourteen of the former and four of the latter are not yet printed.

A series of maps of the boundary between British Columbia and Alberta, as defined by the Interprovincial Boundary Commission are being prepared but are not yet completed.

SPECIAL SURVEYS DIVISION.

Base Line Surveys.

An examination of the returns of survey of all base lines and meridians is being made. The object of this work is to determine definitely the latitudes and longitudes of the monuments on the governing lines of the Dominion Lands surveys and, where possible, to correct the positions of any monuments originally established in error. For the requirements of the new surveys the determination of the latitudes of monuments already established has been more urgent than that of the longitudes and for this reason the greater proportion of this work so far has been given to determining their positions in latitude.

In conjunction with this work, two surveyors have been employed in the field, one in making retracements, and the other in taking latitude observations. Since 1910 latitude observations with the large zenith telescope have been taken at twenty-two points in the Dominion Lands surveys system. Of these, ten determinations were made in 1915. After being carefully checked over, the results of all the observations taken were applied to ascertaining the latitudes of monuments already established on base lines and meridians. In the application of these to the surveys it has been found that, in consequence of local attraction, a very appreciable difference exists at a number of the observation stations between the astronomic and the geodetic values for the latitude. It was therefore necessary to combine the results obtained at the various stations by connecting them by reliable survey lines, thus forming, as nearly as the accuracy of the line surveys will permit, a common datum to replace individual astronomic values. From this datum the latitudes of all other corners on base lines and meridians have been derived. In this way also it has been found possible to determine approximately the magnitude and direction of the local attraction at those latitude stations where the attraction is large. The accuracy of such determinations cannot be claimed to be closer than two chains. Owing to the great areas covered by the surveys, a limited number of latitude stations must necessarily be widely scattered, and the connecting line surveys over the long distances between stations have not the accuracy required for detecting the smaller local

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attractions. At six stations out of twenty-two, differences of two chains or more in latitude have been caused thereby. The particulars of these are as follows:—

Location of latitude station.	Astronomic value of latitude.	Geodetic value of latitude.	Difference.
1. NE. cor. sec. 13, tp. 57-1-3.....	53°56'01".77	53°55'59".66	3.25 chains.
2. " 13, " 24-1-5.....	51°03'10".94	51°03'09".49	2.23 "
3. " 1, " 80-1-6.....	55°54'43".13	55°54'47".38	6.53 "
4. " 12, " 69-1-3.....	54°52'47".21	54°52'43".35	5.94 "
5. ¼ " 32, " 60-21-Pr.	54°14'25".97	54°14'22".26	5.70 "
6. NE. " 36, " 32-1-2.....	51°47'44".99	51°47'43".04	2.47 "

At the remaining sixteen stations smaller variations than two chains occur.

With the exception of a few lines in the vicinity of the Rocky mountains, and a few other lines which have been noted for retracement, the latitudes of all corners on base lines have been definitely determined. Plans have been prepared showing the positions of the monuments relatively to their theoretic positions, and also with respect to sea-level. This has entailed a very large amount of work. The returns of survey for over 20,000 miles of lines required examining, and to do this satisfactorily the records for as many more lines other than the governing lines for the purpose of providing checks on the work. Deflections in the lines were carefully calculated from the bearings returned in the field notes after the azimuth observations had been checked, and closings calculated and compared with computed theoretic values. From the returns of the levelling operations the elevations of the various lines above sea-level were ascertained, and for these elevations the required corrections to distances were computed and applied. On the older survey lines no levels had been taken, and information respecting elevations thereon had to be gathered from other sources. The required corrections, however, were in all cases applied. The corrected values for the various portions of all the lines were finally transferred to the plans being prepared and each base line given the latitude thereon which represents its actual position on the ground. When the first draft of the plans was completed the surprise came. The wonder is, not that some errors were found, but that the surveys fit together as well as they do, when the immense areas they cover are considered. Much work yet requires to be done before the longitudes of all corners are ascertained with the same accuracy as the latitudes.

Associated with the work of determining the latitudes and longitudes of monuments on base lines and meridians, is the work of determining the position of monuments erroneously established, registering the corrections required and by whom and when these corrections are made; computing closings and width of fractional ranges for new base lines to be surveyed; drafting instructions for the surveys of base lines, initial meridians, lines requiring retracement, and for the taking of latitude observations, and in général those matters relating to the control of the governing lines of the Dominion Lands surveys system.

Astronomical Work.

Azimuth Observations.—The observations for the azimuth of base lines and meridians surveyed during the season 1914-15 have been examined and have shown the same high degree of accuracy as those of the previous season. About twelve hundred observations were checked and the bearings of over twelve hundred miles of original line and a thousand miles of retracement survey were compared with these results. The field notes show a very small error to be left in the line, the mean

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deviation from theoretic being less than six seconds; and as this error may be positive or negative the resultant error in the line is extremely small. The observations have been taken frequently enough to give good control of the line, the average distance between stations being less than five miles. While most of the surveyors follow the instructions in the Manual to observe every four miles or thereabouts, some have failed to observe with this frequency, thus bringing the average considerably above four miles. All follow fairly well the practice of taking two or more observations at a station. Deflections are seldom made on the strength of a single observation, and then only when weather conditions prevent the completion of a set. During the season only four such cases occurred. Other single observations were used merely as checks on other observations, or in cases where the conditions of running the line made it reasonably certain that the bearing was practically theoretic. The practice of taking single observations is not approved, as they give no idea of the accuracy of the observing and recording. When two or more observations are made at a station, the difference between the extreme values, that is the range of the results, is some indication of this accuracy. The average range for the season's work was less than ten seconds, and one observer had the remarkably low average of 4".3.

In order to give the surveyor the benefit of criticisms suggested by his work, an effort is now made to have the observations checked and reported on before his return to the field for the next season. He can thus see in what respects his observing can be improved. Because of the reduced staff, only a small part of the work for the season 1915 has as yet been examined, but this portion shows the benefits of this course.

Latitude Observations.—One surveyor was engaged in latitude work and took ten observations with the zenith telescope. One on the Third meridian at township 68 was taken before the ice broke, and the others during the summer season. Of these, two were on the intersections of the Hudson Bay railway with the Principal meridian and the 16th base line west of the Principal meridian; four were in the vicinity of the Principal meridian in township 26, range 9, east, on the 5th base in range 7, east of the Principal, on the 8th base in range 5, east of the Principal, and on the 10th base in range 5, west of the Principal; three were on the 9th base at its intersections with the Second, Third, and Fourth meridians.

The Catalogue of Stars published by this office was used and proved a great convenience. It is mentioned in the introduction that the positions of the Ambronn stars are not considered as accurate as those of the other catalogues. This was clearly shown in the results of the latitude observations for this year. The average probable error of the first four observations, in which Ambronn stars were used, was $\pm 0''.049$, while that of the last six, in which they were not used, was $\pm 0''.032$. A similar improvement was shown in the probable error of a single observation due to observing and declination, which was $\pm 0''.46$ in the first four, and $\pm 0''.29$ in the last six. As the probable error due to observing alone is almost the same in both cases, this difference must be due to declination errors. Also, of the nineteen pairs rejected, two containing G5039 were rejected because of declination errors, three were observed under unfavourable conditions, and the other fourteen, consisting of eight different pairs, contained Ambronn stars. It is thus seen that the exclusion of Ambronn stars increases the accuracy of the results.

Astronomical Field Tables.—The Star tables for November and December, 1916, September and October, 1917, July and August, 1918, January, February, and March, 1917, and April, May and June, 1918, and the tables for the right ascension and the declination of the sun for 1917 have been compiled and printed. For the Star tables, owing to the continual motion of Polaris, it became necessary to compute new primary tables. These were type-written and then photographed on forms suitable for the computation of the field tables. The right ascension and the declination of the sun are now given in the same folder with a table for the sun's refraction and

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parallax. This table is given with the apparent altitude as argument, and contains the combined amount of refraction and parallax, and the corrections to this for barometric pressure and temperature.

Magnetic Survey.

Sixty-two surveyors were instructed to observe for magnetic declination, and during the surveys made by R. C. Purser, D.L.S., and C. M. Walker, D.L.S., observations for magnetic dip and total force were taken at twenty-five stations. The results are given in Appendix 72. The instrumental constants of the dip circles as determined at Agincourt both at the beginning and end of the survey season show a probable error of less than 0.00010 c.g.s. in each case from the mean of at least six observations. At every station a complete observation for magnetic dip and total force, consisting of a dip, a total force and a dip, was taken. This observation was always duplicated and the average range found to be comparatively small.

The index correction to the compass of every transit used for observing was determined both at the beginning and end of the survey season. If the change was small the mean correction was used in the reduction of the observations. If a serious discrepancy was found between the two determinations it was investigated, and if the discrepancy could not be satisfactorily explained the observations taken with the instrument were rejected. Every observation for magnetic declination has been reduced, checked, and plotted on a large-scale map. They have been reduced to the mean of the month in which they were taken by means of the daily records of the declinometer at Agincourt, except those that were taken at times when the records were not observed. In the appendix such observations are marked with an asterisk.

In the reductions of the observations to a common epoch, we are handicapped by the absence of a magnetic observatory in the Northwest. Agincourt is too remote from the territory covered by our observations. There is no surety that the daily variation at Agincourt and at, say Edmonton, is always the same or that all magnetic disturbances felt at Edmonton are recorded at Agincourt, and *vice versa*. For this reason we have been anxious for some years now to have the Meteorological Service start a magnetic observatory in the Northwest. The only equipment necessary for our requirement is a self-recording declinometer. The director of the service has the instruments, but has experienced difficulty in getting a competent observer. It is hoped that the observatory will be in operation for the summer of 1916.

Returns received for 1915.. . . .	2,147
Previous returns since 1908.. . . .	6,853
Total returns to date.. . . .	9,000
Dip observations received for 1915.. . . .	85
Previous returns since 1908.. . . .	351
Total force observations for 1915.. . . .	59
Previous returns since 1908.. . . .	260

Surveying Instruments.

As in the previous year, the instrumental equipment of the surveyors employed in the field was listed and, where thought advisable, inspected so that the office might be satisfied that only instruments in good condition and of approved pattern were being used on the surveys. It has been found that unless this is done there is a tendency among some surveyors to use instruments which are worn out and no longer fit for service.

Repairs were made to ninety transit theodolites, nineteen dumpy levels, twelve surveying aneroids, six surveying cameras, two abney levels, two recording thermometers, five stadia rods, eighty-five rod levels, and fifteen tripods.

Twenty-five sidereal watches were sent away to be overhauled and readjusted.

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To give an idea of the volume of work in connection with the instruments, it may be stated that 455 cases of surveying instruments aggregating ten tons (20,054 pounds) were shipped from this office during the past year, and 179 cases aggregating $3\frac{1}{2}$ tons (7,789 pounds) received.

A statement of the surveying instruments on hand on March 31, 1916, showing also the instruments purchased and sold during the year is given in Appendix 74.

General Work.

The Supplement to the Manual has been revised and the tables carefully checked by an independent computation. Two of the tables have been extended, and three which are not now used have been omitted. The text has been completely revised, and parts which had become out of date have been rewritten. There have also been added full descriptions of the astronomical and magnetic observations which are required by Dominion Land surveyors, and how they may best be taken. This matter formerly appeared in part in the Manual. New specimen observations have also been prepared.

An illustrated pamphlet has been prepared on the block survey transit describing and explaining the use of the specimen observations for azimuth, latitude, etc. The explanations are mostly those peculiar to this instrument, and not readily obtainable in text-books. The subject is covered fully, and the instructions with illustrations and sectional cuts afford a ready and comprehensive reference for the surveyor in the field. This pamphlet is now in the press.

In the rough mountainous country of the British Columbia railway belt a considerable amount of the surveyors' and assistants' time is taken up in computing the corrections required to reduce the distances chained on the slope to the horizontal. In the prairie provinces of Manitoba, Saskatchewan, and Alberta the surveyors use slope correction tables issued in convenient card form by this office for their reductions. But these tables are not sufficiently complete nor extended far enough for the steep slopes encountered in British Columbia, and it has been the practice of nearly all, if not all, the British Columbia surveyors in the past to use either natural or logarithmic tables to compute these corrections. Last year, specially complete and extended slope correction tables were computed, printed, and issued for the British Columbia men. This year, to further facilitate their work, "slope correction slide rules" have been designed and issued to them. These slide rules are simply the standard ten-inch Mannheim slide rule with a scale of versines in place of the usual scales of logarithms and tangents. Slope corrections for distances up to five chains and for slopes up to twenty-six degrees can thus be taken out with an accuracy of one-tenth of a link. The use of the rule is further extended by the addition of another standard number scale on its face, by which the difference of elevation in feet is given simultaneously with the slope correction. The rule has been very favourably received by the surveyors.

On Stadia and other traverses it is often rather difficult to locate survey posts upon which it is desired to tie or check. A general idea of the locality of the post sought for is afforded by roughly calculating the latitudes and departures of the lines. A rapid approximate method of making these calculations is supplied by an abacus which has been designed for this purpose and pasted in the back of the book for "Field Notes of Stadia Traverses."

The various methods of rapidly solving the astronomical triangle for time and altitude, azimuth by means of the abacus, the homogram, the solar attachment tables, etc., are under investigation. It is hoped that this interesting matter will be available for publication in the near future.

Surveys Laboratory.

Complete tests were made of twenty-six D.L.S. subdivision transits, four hydrographic survey transits, eight survey cameras, six clinometers, ten telescopes, four micrometers, two binoculars, and one monocular. Partial tests were made of seventy-one subdivision transits.

A complete analysis was made of the graduations of the horizontal circle of one of the base-line transits. This consisted of the determination of the eccentricity and ellipticity of the pivot, the periodic and accidental errors of graduation, the probable errors of the microscopes, of the graduations, etc.

Forty-one sidereal watches and five mean-time watches were submitted for trial, and forty-two of these passed through complete tests; the remaining four were withdrawn before the tests were finished.

Of the forty-two completely tested watches, thirty-two were put through the Surveys Laboratory test of forty-four days, eight passed the test and were then tested for fifty-five days according to the Bureau of Standards method, and ten were tested according to the Bureau method only.

Of the thirty-two watches completing the Surveys Laboratory test, twenty-one, or sixty-six per cent, passed as against thirty-nine per cent in 1915. Of the eight subjected to both tests, five passed and three failed the Surveys Laboratory test, and one passed and seven failed the Bureau of Standards test. Of the ten completing the Bureau of Standards test only, seven passed and three failed.

The results of the trials of the watches which passed are given in Appendix 73.

For the twenty-one which passed the Surveys Laboratory test, the average errors for isochronism were as follows:—

F.U.	P.R.	P.L.	D.U.	D.U.	D.U.	D.D.	P.U.
0s.49	0s.39	0s.52	0s.60	0s.41	0s.34	0s.41	0s.76

The smallest error for α was 0^s.23.

The average errors for position were

P.U.	P.R.	P.L.	D.U.	D.D.
2s.76	2s.73	2s.19	1s.35	1s.53

The smallest error for β was 0^s.75.

The average temperature coefficient was 0^s.09.

Comparing the average errors with those for 1915 we have the following:—

	1915.	1916.
Average error for isochronism.. .. .	0s.53	0s.49
“ position.. .. .	1.89	2.08
“ compensation.. .. .	0.08	0.09

The largest average error in isochronism for both those which passed and those which failed was, as in 1914, in the P.U. position. The lowest average error for those which failed was, as in 1914 and 1915, in the D.D. position, but for those which passed it was in D. U. position.

In position, the largest average error for those which passed was, as in 1914 and 1915, in the P. L. position.

Of the watches which failed, four, or thirty-six per cent, failed in isochronism, nine, or eighty-two per cent, in position, and two or eighteen per cent in both isochronism and position.

All passed the test for temperature of compensation.

In connection with the testing and rating of the watches, thirty-eight time observations were taken.

One hundred and fifty stadia cards were computed, printed, and issued to the surveyors.

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At the Comparator building, the base was verified seventy-one times by the standard four-metre rule; eighty intercomparisons of the laboratory standards and four hundred and twenty-nine comparisons of the standards with the base were made. Besides the above, the lengths and weights of twenty-one tapes of all kinds were determined and three elasticity tests were made.

At the Surveys Laboratory, part of a proposed electric heating system has been installed in order that the experiments may be carried on at a more nearly standard temperature during a longer period of the year than has previously been possible. Progress has continued to be made in improving the apparatus. A second testing stand has been installed for determining stadia constants, value of micrometer screws, etc., so that during busy periods instruments may be turned out at a much faster rate. Work at the Surveys Laboratory, however, is becoming very much handicapped by lack of space. The main room in which the greater portion of the tests are carried on is but eleven feet by sixteen feet, is quite inadequate for the amount of apparatus installed therein and is very cramped when more than two observers are working at the same time on different tests.

Comparator.

The comparator standard has been a four-metre invar bar. Invar has a very low coefficient of thermal expansion but unfortunately is subject to molecular change, especially when exposed to shock or extreme temperature variation. It is therefore necessary that such a standard should be verified fairly frequently. It was originally intended to return the bar from time to time to the International Bureau at Paris for recomparison with the international standards. The vicissitudes through which the bar passed on its first journey here showed clearly however that this was not practicable. After considerable thought had been given to this matter and several letters had passed on the subject with Dr. Guillaume, the Director of the International Bureau, it was finally decided to purchase a one-metre bar for our primary standard. There would be no difficulties connected with the transportation back and forth to Paris of a one-metre bar and it could be verified as often as desired. As the interval between piers (four metres) still required the four-metre bar to be used in all comparator measurements, the four-metre bar would be verified by comparison with the one-metre bar. This plan has the added advantage that the primary standard is not constantly in use as is the case with the four-metre bar and the danger of accidents to our primary bar is thereby very materially lessened. In order to permit verification of the four-metre bar by the one-metre standard some additional apparatus was required and the installation of this has just been completed. On the original comparator only multiples of four metres, ten metres, thirty metres, fifty feet and sixty-six feet could be standardized. The auxiliary apparatus increases the range of the comparator so that now any length may be standardized. While the apparatus has been installed the one-metre bar has not as yet been received, owing to various delays mainly arising out of the troubled conditions in Europe.

A short description of the primary base apparatus is given herewith. It is a general description given in advance of a more complete one at present delayed awaiting the completion of some exhaustive experiments. Results are also given of the friction tests on the tape-supporting pulleys of the base apparatus. Those for the secondary apparatus were given in the report for 1914-1915.

Comparator Building.—One of the most difficult problems in the standardization of measures of length is in controlling and determining the temperature at which the standardization is made. For this reason it was necessary to construct a building of unusual and special design. It is necessary that the exact temperature of the tape be known and that this temperature be uniform throughout its length. The building had to be such that a constant internal temperature could be maintained for long

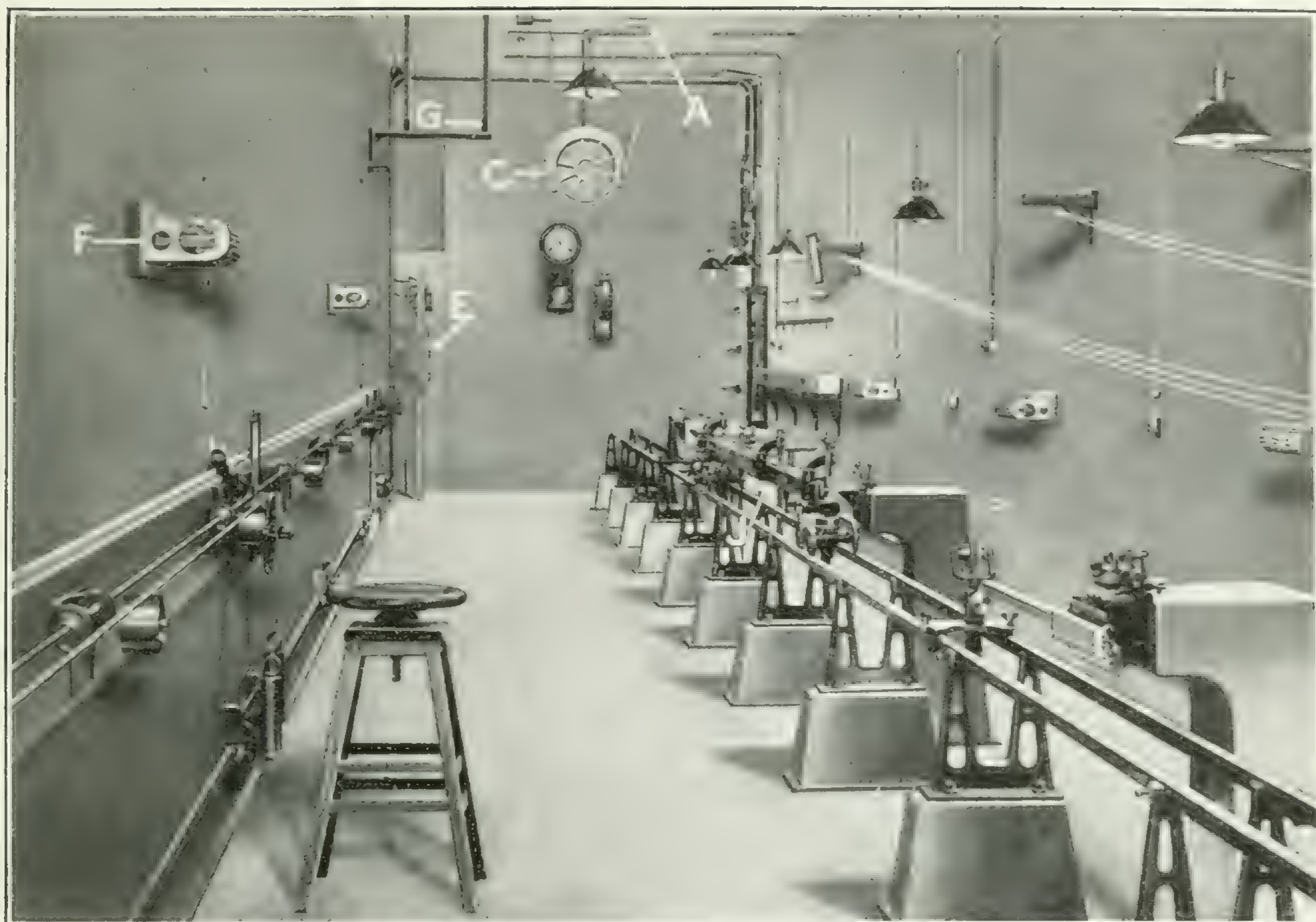


Fig. 1. North End.



Fig. 2. South End.
View of Comparator Room.

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periods independent of outside conditions and also that the temperature could be regulated to as near as possible the standard temperature for testing ($16.7^{\circ}\text{C}.$).

These objects are attained by insulating the walls, floor and roof of the testing room and keeping the openings to the outside air down to the minimum necessary for proper ventilation and by the provision of a system of electric heaters. A pair of blower fans supported from the ceiling at each end of the room (C) Figures I and II, serve to keep the air in circulation and so maintain a uniform temperature throughout the room. In the extremely hot weather the ventilators are opened at nights only and the fans kept running. The inside dimensions of the main room are 150 feet long, ten feet six inches wide and twelve feet high. The walls are approximately four feet thick and consist of five thicknesses of brick, a one-inch air space, one-inch wood sheeting, tar paper, eighteen inches of shavings, one-inch wood sheeting, four-inch air space, tar paper, and finally double wood sheeting. Between the ceiling and the roof is a layer of shavings four feet thick, and beneath the floor a layer two feet in thickness; under this are cinders for a depth of five feet to the solid rock. The only openings besides the door are two air intakes (B) Figure II, one at each end of the room, and four ventilators (A) Figure I, in the ceiling. The air intakes (which are at the base of the wall) are arranged so that the quantity of air admitted can be regulated, and during the tests can be completely shut off. The ceiling ventilators can be closed completely or opened any desired amount for ventilation. The exit into the outer room is of special construction, consisting of two doors with a four-foot air space between. The outer door is of the ordinary type, while the inner one is an insulating air-tight door of the refrigerator design.

The heating system consists of eighteen electric heaters (D) Figure II, evenly distributed around the base of the walls, and one large heater in each of the two air inlets. The heaters are of the three-stage type, giving low, medium, and high degrees of heat, and are arranged in two separate circuits (independent of the air intake heaters). They may be controlled closely from a Vermont marble switchboard (E) Figure I.

At all ordinary times the temperature of the room is regulated to about $16.7^{\circ}\text{C}.$, this being the temperature at which the base measurements are made. A recording thermometer gives the degree of regulation attained and the smoothness of the curves of temperature show how well the building is insulated.

Comparator Apparatus.—Generally speaking, the existing bases for the standardization of wires and tapes are of two kinds: First, the permanent bench-marks of microscopic construction (*e.g.*, Russian bases at Petrograd), and secondly, the permanent bench-marks consisting of lines traced on the edges of a series of polished surfaces fixed in positions (*e.g.*, bases at Bureau International and the National Physical Laboratory). After careful consideration, the latter of the two systems was adopted. The apparatus was constructed by "La Société Genevoise, Pour la Construction d'Instruments de Physique," Geneva. The permanent base consists of a concrete monolith supported on the solid rock with piers bearing the bench-marks projecting up through the floor at certain intervals. These piers are situated at 0^{m} , 4^{m} , 8^{m} , 10^{m} , 12^{m} , 50 feet, 16^{m} , 20^{m} , 66 feet, 24^{m} , 28^{m} , 30^{m} , 100 feet and 32^{m} . The bench-marks consist of highly polished plates bearing fine graduations, fixed in cast-iron brackets bolted to the front of the piers. These brackets also bear small electric lamps for illuminating the fields of the micrometer microscopes and rests for supporting tapes when being compared with the bench-marks.

In front of the bench-mark piers throughout nearly the whole length of the room a series of smaller piers carry rails. The carriage bearing the rule, microscopes, etc., travels along these rails which also serve as a support for the pulley brackets, end fixtures, and other attachments used in comparing tapes with the bench-marks. The carriage consists of a piece of trussed angle-iron supported at each end by a three-wheeled truck. There is an independent raising and transverse adjustment at

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each end, the truck at the north end having also a clamp and slow-motion screw attachment for making longitudinal adjustment when setting the bar in position for reading. Supported at two points at a distance of 2.26^m apart on the carriage is the invar bar four metres in length, one end resting on a saddle and the other on a roller. On the back of the angle-iron are slides on which fit the brackets carrying the micrometer microscopes, one being used always at each end of the carriage and the third at any intermediate part when piers of less than four metres spacing are being standardized. The bar is protected from air currents and accident by a metal casing having small openings covered by slides so that the bar may be brought close up to the bench-mark. The bar is of special section with graduations on the neutral surface. The first metre is divided into millimeters and the other graduations are at 2^m, 2.48^m, 3^m, 3.24^m and 4 metres, one millimetre being shown on each side of these latter graduations. Two thermometers record the temperature of the bar. The bulbs are enclosed in invar blocks making metallic contact with the bar and small microscopes in the protecting cover on the carriage enable the thermometers to be accurately estimated to .01°C., the graduations being in tenths of a degree. The micrometer microscopes have a magnifying power of about twenty. A micrometer is fixed in the focus of the eye-piece consisting of a fine screw, with 2.19 threads per millimetre and a pair of close parallel hairs carried by a frame. The drum is divided into 100 parts and one turn corresponds to 0.1^{mm}. The exact value of one turn is obtained after the adjustments are checked before establishing the base and after the measurement, the mean of the two values being used in reducing the results. The four-metre bar was standardized and its coefficient of expansion determined at the Bureau International. At 0°C the length between 0^m and 4^m graduations is 3.999975^m and the coefficient of expansion is (0.000001738T-0.00000000509T²). To protect the bar from a local heating effect due to the breath of the observers when readings are being taken, detachable breath-shields are fitted to the microscope brackets.

During tape tests the carriage is moved beyond the end pier. Tapes when compared with the bench-marks may either hang in a single catenary, (the rail brackets being of U form to allow of this method of test) or be supported at close intervals on special pulleys. Tension is imparted by a wire fastened to one end of the tape and passing over a grooved pulley, weights being added to the wire according to the desired tension. The pulley is of steel twelve inches in diameter, running on ball bearings with fine adjustment both vertically and horizontally. The other end of the tape is attached to a support giving longitudinal, transverse, and vertical adjustment. It has been found that owing to the small amount of friction in the apparatus in its improved form, it is necessary to have one end of the tape fastened to a fixed point in order that it will remain stationary during readings.

Twelve mercury thermometers (Tonnelot) are supported horizontally in protecting guards at intervals around the walls. These thermometers have been carefully standardized and from time to time their ice points are verified by the usual method. They are graduated to one-tenth of a degree (C) and are estimated to one-hundredth of a degree. A reading is taken when observers change places at the middle of the test and the mean reduced temperature of the twelve thermometers gives the temperature of the air in the room during the comparison. In order that the temperature of the observer's body may not affect the reading of these delicate thermometers they are viewed from a distance by means of a special reading telescope designed for the purpose and supported on the rails in front of the bench-marks. When the atmospheric pressure is abnormal corrections have to be applied to the observed readings. A mercury barometer hangs on the wall at the door end of the room for obtaining the pressure at the time of testing. An error of 1/10° C. in the temperature of a 100-foot tape would cause an error of 0.0001 feet in the computed length.

Variation of Base.—In September, 1914, a series of experiments was started with the object of investigating the alterations in length of the base during the year and to

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determine to what extent any variation found would affect the ordinary testing. The length has been determined weekly since the commencement of these experiments which are still proceeding. The results of the first year's work are given herewith in graphical form together with a curve showing the mean outside temperature during the same period. The vertical scales for the three distances shown in the curves are inversely proportional to the distances themselves i.e., if the alterations in length were proportional to the pier spacing, the difference of ordinates would be constant. It will be noticed that the change in length is very regular for each distance and has a distinct periodic appearance, the point of maximum length being in September and the minimum in March. Although the extreme variation of the whole base is about 1^{mm} , not two consecutive weekly determinations differ by more than ninety microns. At times the length has been determined on two consecutive days when the greatest daily variation so far observed has been fifteen microns. This quantity represents a variation of approximately one in 2,000,000 in the total length of the base, so that no appreciable error is introduced in regarding the length of the base as constant for some hours after standardization during which tapes are verified.

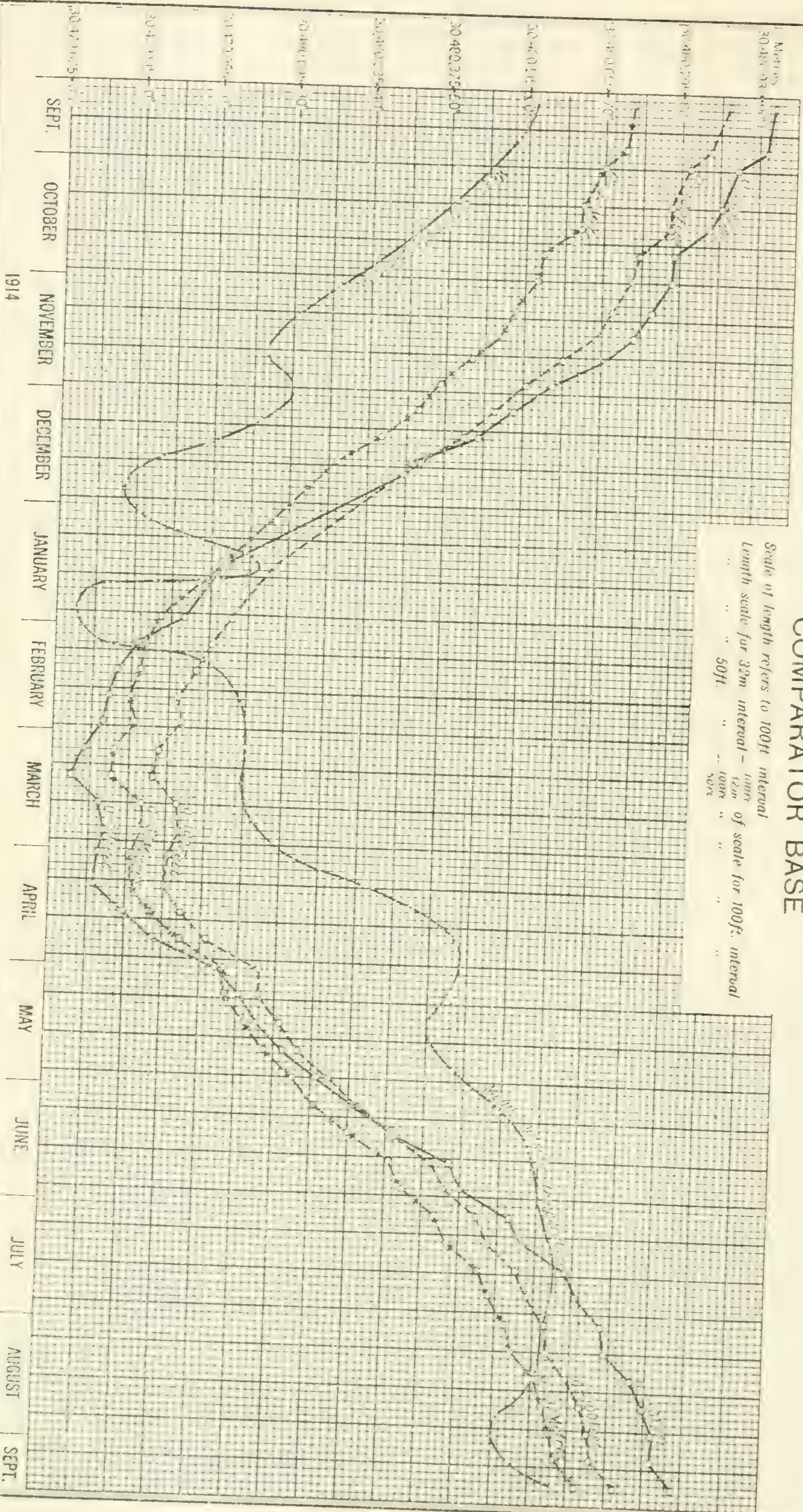
It will be seen that the fifty-foot length has a slightly greater proportional variation than the 100-foot and 32^{m} . Our weekly determinations reveal the fact that the spaces between the piers do not alter quite uniformly, those towards the ends showing the greater variation, the effect being more marked towards the zero end. The form of the curves is similar to that for the air temperature but with a lag of about two months. This appearance is what would be expected if the length of the monolith were affected by temperature. Published results of underground temperature for a depth of a few feet show a similar variation to outside air temperature with a lag proportional to the depth. In this connection it is proposed to install an appropriate thermometer so that the exact temperature of the monolith may be obtained in connection with these investigations of the length of the base.

Friction of tape-supporting pulleys.—The original tape-supporting apparatus as supplied for the permanent base consisted of single pulleys fitted to stands which rest on the rails in front of the bench-mark piers. The pulleys were of brass of heavy section and weighed 1.83 pounds each. They had a vertical adjustment to enable them to be lined up horizontally. The end-grooved pulleys for carrying the tension wire were of similar section and had lateral as well as vertical adjustment. It was felt that the amount of friction in these pulleys owing to their weight and the design of bearings would have an unduly large effect on tape comparisons made with the base apparatus.

Having determined the amount and effect of the friction, it was compared with the results obtained on the new secondary apparatus. The friction was found to be considerably greater, and it was decided to re-design the pulleys with the object of materially reducing it. The experiments which had been carried out on the original pulleys determined the amount of friction in the pulleys and also the effect of friction on the length of tapes when compared with the base. Briefly, the actual amount of friction expressed as a force in the line of tension at the periphery of the pulleys was found by winding a silken thread around the pulley and adding weights until the pulley revolved without any apparent acceleration, this being done for several positions and in both directions of rotation. In the case of the tension pulley the wire used in tape tests was employed, weights being attached to the ends of this in order that the amount of friction might be found under working conditions. The actual effect on the observed length of a tape was obtained by setting the zero of a tape opposite the zero graduation on the base and taking readings at the other end. Settings were made alternately from left to right when the tension at the zero end would be the sum of the tension and the friction, tending to decrease the sag effect and right to left when the opposite would be the case, the tension at zero end being the difference of the tension and the friction. It is apparent that the more friction there is in the pulleys the

DIAGRAM
SHOWING
VARIATION IN INTERVALS
OF
COMPARATOR BASE

Scale of length refers to 100ft interval
Length scale for 32m interval - 100ft of scale for 100ft interval
" " 50ft " 100ft " " 50ft



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more would be the discrepancy between alternate settings, owing to the friction affecting the actual tension in the tape and so altering the amount of sag between the different pulleys. The following is a summary of the results obtained:—

First method.

Amount of friction expressed as alteration of tension in line of the tape.

Tension Applied.	FRICTION.	
	Tension pulley only.	Tension pulley + 7 intermediate pulleys.
10 lbs.....	10·6 grms.	27·8 grms.
10 kgms.....	18·1 “	35·2 “

Second method.

Effect of friction on setting determined by moving tape from opposite directions and comparing with bench-marks.

Tension Applied.	Length of Tape.	MEAN DIFFERENCE OF READINGS.	
		Tension pulley only.	Tension pulley + 7 intermediate pulleys.
10 lbs.....	66 ft.	·035mm	·015mm
10 kgms.....	66 “	·019 “	·035 “
10 lbs.....	100 “	·157 “	·017 “
10 kgms.....	100 “	·029 “	·033 “

After the completion of this test new pulleys were made, these being adapted to the old brackets and stands. The new tension pulley is of steel twelve inches in diameter and the intermediate pulleys of aluminium alloy $3\frac{1}{8}$ inches diameter, weighing 1·93 ounces each. When the new pulleys were installed a further series of similar experiments were carried out. The results of the tests are as follows:—

First method.

Amount of friction expressed as alteration of tension in line of tape.

Tension Applied.	FRICTION.	
	Tension pulley only.	Tension pulley + 7 intermediate pulleys.
10 lbs..	3·2 grms.	3·86 grms.
10 kgms.....	5·3 “	5·96 “

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Second method.

Effect of friction on setting determined by moving tape from opposite directions and comparing with bench-marks.

Tension Applied.	Length of Tape.	MEAN DIFFERENCE OF READINGS.	
		Tension pulley only.	Tension pulley + 7 intermediate pulleys.
10 lbs	66 ft.	.013 mm	.008mm
10 kgms.....	66 "	.003 "	.005 "
10 lbs.....	100 "	.021 "	.011 "
10 kgms.....	100 "	.012 "	.012 "

PHOTOGRAPHIC OFFICE.

Owing to the reduction in our staff due to the absence of one member, who is on active military service, and to other unusual conditions, the output of the photographic office shows a small decrease.

To avoid procuring extra assistance, as much as possible of the blue and black-line printing was sent to the Railway Lands Branch, where special equipment for doing such work expeditiously is installed. The remainder, such as prints from glass-line negatives, were made, for the time being, by the process photographers.

However, additional work such as developing some hundreds of photographic dry plates used in topographical survey operations, more than made up for the work sent out.

The plates used for this kind of work in the past have been of the ordinary or colour-blind variety, but this season panchromatic plates were used; these, being sensitive to all colours, had to be very carefully handled, that is, the loading into the plate holders and, after exposure, unloading and packing for shipment, had to be done in the dark.

The plates were developed in tanks by the time-and-temperature method, a fixed time of development at a known temperature, say thirty minutes at sixty-five degrees, plates not being looked at till after fixing. The manipulations were, of course, in darkness or practically so.

Although this make of plates was new to us and to the surveyors in the field, the results were good; with further experience both in exposing and developing, they ought to be very satisfactory.

From these and many hundred other survey negatives, which were not developed at this office, contact prints and enlargements were made, the enlarged prints being used in plotting the survey.

To turn out all this so as not to cause any delay to the various parties in plotting their work, and at the same time attend to the other duties of the office, kept our small staff fully occupied, some of the less important work, such as bringing our office albums up to date, being held over.

The fixed focus enlarging camera on which all the survey enlarging is done, and which had been rebuilt in preparation for this season, has proven very satisfactory. It is more compact, more convenient to handle, and the definition of the enlarged print is better than with the old camera. One of the staff attended the Kodak Photographic School held at Montreal for three days. Much valuable information pertaining to photography in general was secured, which will be of benefit in future work.

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PHOTOLITHOGRAPHIC OFFICE.

The duties of this office are to prepare photo-lithos on zinc and aluminum of maps, plans, etc., for the power printing presses, and also the making of reductions and enlargements for the convenience of the drafting division.

These photo-lithos are made from drawings in black drawing ink, prepared by the drafting division. First a negative is made and then carefully retouched, spotting out all defects and correcting any errors. A sheet of specially grained zinc is coated with a sensitized solution, and when dry is exposed to the light, when it is then inked in. This is developed under running water, dried off with a fan, and sent to the press for printing.

During the past year over one thousand township plans have been put through in this manner, together with three- and six-mile sectional maps and various forms of townsites and other plans.

Some of the higher-class maps published in this office are first engraved on copper. Experiments are now being carried on in copper-plate intaglio etching to take the place of these plates at a reduced cost.

There is a slight decrease in the number of negatives this year compared to last year, but a greater number of the larger size were made.

We are now prepared to copy coloured maps, and other documents by the aid of panchromatic plates and coloured filters.

BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

The Board of Examiners for Dominion Land Surveyors held three meetings. The first was a special meeting lasting from May 3 to June 25 (inclusive), 1915, during which examinations were held at Ottawa, Toronto, Winnipeg, Calgary, and Dawson. The second was another special meeting which took place on September 24, 1915. The third was the regular annual meeting called for by section 9 of the Dominion Lands Surveys Act. It began on Monday, February 14, 1916, and lasted until March 31, 1916. During this meeting examinations were held at Ottawa, Toronto, Montreal, Kingston, Winnipeg, Calgary, Edmonton, Vancouver, and Dawson. The total number of candidates for examination was 202. Of these, 144 tried the preliminary examination, 55 tried the final examination, and 3 tried the examination for Dominion Topographical surveyor.

Thirty-seven candidates were successful at the preliminary examinations as follows:—

PRELIMINARY EXAMINATION.

Atkins, Samuel Clements, Ottawa, Ont.	Hogarty, Bertrand, Portage la Prairie, Man.
Atkinson, Nelles Henry, Calgary, Alta.	Huggins, Frank William, Ottawa, Ont.
Bayly, Gilbert St. John, Rocky Mt. House, Alta.	Hurlbert, Bernard Hatfield, Tusket, Yarmouth, Co., N.S.
Berton, Francis George, Dawson, Y.T.	Moorehouse, Edmund Lloyd, Medicine Hat, Alta.
Boyle, Joseph Whiteside, Dawson, Y.T.	Ogburn, Robert Henry, Dawson, Y.T.
Breen, Joseph Melville, Long Branch, Ont.	Pearson, Grant Price, Schomberg, Ont.
Brennen, James Hugh, Ottawa, Ont.	Read, Hiram Earle, Edmonton, Alta.
Brennen, Herbert, Ottawa, Ont.	Robertson, Douglas Mills, Edmonton, Alta.
Chisholm, Austin Joseph, Woodstock, Ont.	Rochester, Bertram Cole, Ottawa, Ont.
Cole, Arthur William Willoughby, Ottawa, Ont.	Rose, Hugh Grant, Ottawa, Ont.
Cunningham, Frederick J., Ottawa, Ont.	Scott, Cecil Raymond, North Bay, Ont.
Dalglish, Bruce M., Ottawa, Ont.	Stewart, James R., City View, Ont.
Davis, Vernon R., Franklin, Man.	Thompson, William Kirk, Toronto, Ont.
Dewar, Charles Leonard, Ottawa, Ont.	Thomson, Alexander Muir, Ottawa, Ont.
Dunbar, John Robert, Ottawa, Ont.	Wadge, Harold, Regina, Sask.
Elliot, Herman James, Toronto, Ont.	West, Gordon O., Ottawa, Ont.
Evans, William Lloyd, Hamilton, Ont.	Williams, Howard J., Kingston, Ont.
Gordon, Donald Cameron, Ottawa, Ont.	Wood, George H., Kincardine, Ont.
Henderson, John Archibald Hamilton, Ottawa, Ont.	

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Twenty-seven candidates were successful at the final examination as follows:—

FINAL EXAMINATION.

Ball, Alfred Nepean, Grenfell, Sask.
Britton, George Clayton, Whitby, Ont.

Carroll, John, Toronto, Ont.
Clouston, Noel Stewart, Winnipeg, Man.
Cram, Alexander Scott, Westboro, Ont.

Davidson, R. Douglas, Port Rowan, Ont.

Fullerton, James Thornton, Victoria, B.C.

Gardner, James David, Ottawa, Ont.

Keeping, Kimball, Murray Harbour, P.E.I.
King, Arthur Harry, Maitland, N.S.
Knight, Sidney, Edmonton, Alta.

McIntosh, John Stuart, Morrisburg, Ont.
McLaren, Arthur Anthony, Mitchell, Ont.

MacTavish, William Higgins, Van Camp, Ont.
Mills, Thomas Stanley, Kingston, Ont.
Murdie, William Campbell, Seaforth, Ont.

Phillips, Edwin Percy Aryall, Oshawa, Ont.

Riddell, John Morrison, Toronto, Ont.
Robinson, Edward Keith, Kingston, Ont.

Sauder, Penrose Melvin, Calgary, Alta.
Sibbitt, William Algernon, Bracebridge, Ont.
Smith, Leonard Ross, Richdale, Alta.
Stewart, Alan D., Ottawa, Ont.

Thomas, Llewellyn Olding, Ottawa, Ont.

Wight, Edmund James, Ottawa, Ont.
Wood, Norman C., Kamloops, B.C.
Wood, James Russell, Peterboro, Ont.

The time of the board, during the meetings, was largely taken up with the reading and valuation of the candidates' answer-papers. Complete sets of question-papers, to be used at the next examination, were also prepared. In addition to this, the evidence submitted by candidates at the final examination, in proof of their eligibility therefor, had to be examined. This evidence consisted of certificates of Provincial land surveyors, and of affidavits of service under articles of apprenticeship.

Nine candidates who presented themselves for final examination, had not quite completed their time under articles. They were admitted on the understanding that in case they were successful, their commissions would not issue until they had completed their apprenticeship and furnished affidavits in the regular form.

The board had to consider several applications which were received from college and university graduates asking to be admitted to the privileges of section 22 of the Surveys Act which provides for a shorter term of service under articles. One candidate who produced a diploma from McGill University, showing that he had successfully passed the third-year examination in civil engineering, was admitted to the shorter term of service.

Thirty commissions were issued to candidates who had passed the final examination, and had furnished oaths of office and allegiance and bonds for the sum of one thousand dollars, as required by section 25 of the Dominion Lands Surveys Act.

Twenty-seven certificates of preliminary examination were issued to successful candidates who had complied with the requirements of the law.

Section 35 of the Dominion Lands Surveys Act provides that every Dominion Land surveyor shall be in possession of a subsidiary standard of length. During the year, twelve new standards were issued to surveyors. Two Ontario Land surveyors, who were also Dominion Land surveyors, sent their O.L.S. standard measures to be tested. These being in good condition and of the same pattern as the Dominion standard, they were tested at the Surveys laboratory and re-issued as subsidiary standards of length.

Under the provisions of section 53 of the Dominion Lands Surveys Act, the following fees must be paid to the secretary by each candidate who has successfully passed the examination for admission as a Dominion Land surveyor:—

(f) By each applicant obtaining a commission, two dollars;

(g) For admission to practise after receiving a commission, twenty dollars.

Hitherto, the secretary had collected the two fees (f) and (g) on the issue of the commission, which was considered to be the "admission to practise." In March last, however, the Deputy Minister of Justice advised that the right to a commission and

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the right to practise are two separate things, for which separate fees are payable. As no surveyors apply for admission to practise, the collection of the fee of twenty dollars, (g) has practically ceased.

APPENDICES.

- No. 1.—Schedule of surveyors employed and work executed by them.
No. 2.—Schedule showing for each surveyor employed, the number of miles surveyed of section lines, township outlines, traverses of lakes and rivers, and resurvey, also the cost of the same.
Nos. 3 to 71.—Abstracts of reports of surveyors employed.
No. 72.—Results of magnetic observations.
No. 73.—Results of watch tests.
No. 74.—List of surveying instruments on hand, March 31, 1916.

MAPS AND PROFILES.

The following maps accompany this report:—

1. Map to illustrate progress of Dominion Land Surveys, to March 31, 1916.
2. Map showing topography and profiles of base lines and meridians run during the year.

I have the honour to be, sir,
Your obedient servant,

E. DEVILLE,
Surveyor-General.

TOPOGRAPHICAL SURVEYS BRANCH.

SCHEDULES AND STATEMENTS.

APPENDIX No. 1.

SCHEDULE of Surveyors employed and work executed by them.

Surveyor.	Address.	Description of Work.
Akins, J. R...	Ottawa, Ont...	Production of the Sixth meridian from the NE. cor. tp. 90 to the NE. cor. sec. 12, tp. 127; the 27th base line from the NE. cor. sec. 33, tp. 104-22-5, to the Sixth meridian; and the 30th base line across part of range 1, west of the Sixth meridian. Resurvey of the 29th base line across range 24, west of the Fifth meridian.
Aylsworth, C. F...	Madoc, Ont...	Retracement in tp. 12-10-E., tps. 24 and 25-27-Pr., tp. 26-30-Pr., and tps. 23, 28 and 29-31-Pr. Resurvey of the north outline of tp. 12-9-E. Stadia surveys in tp. 23-27-Pr. and tps. 24 and 25-28-Pr.
Baker, J. C...	Vermilion, Alta...	Subdivision of tp. 94-10-4, tps. 94 and 96-11-4 and parts of tps. 95 and 97-11-4. Traverse in tp. 95-10-4.
Baker, M. H...	St. Thomas, Ont...	Resurvey in tp. 17-11-E., tp. 4-17-Pr., tp. 24-2-2, tp. 28-18-2, tps. 30, 31 and 38-26-2, tps. 30 and 31-27-2, tps. 30 and 31-28-2, and tp. 28-7-3. Retracement in tp. 25-22-Pr., tp. 44-25-Pr., tps. 1 and 2-8-2, tps. 1 and 2-9-2, and tp. 22-23-2. Correction survey in tp. 37-26-Pr., tp. 19-8-2, tp. 7-10-2, tps. 24, 25 and 27-24-2, tp. 40-26-2, and tp. 51-3-3. Survey of parcel of land for water-power reservation in sec. 23, tp. 15-12-E. Survey of portions of the old Dawson road in tp. 8-6-E., tp. 8-7-E. and in the parish of Ste. Anne des Chênes. Survey of agricultural land in tp. 15-4-Pr. and of cemetery in sec. 17, tp. 5-27-2. Traverse of road along the north shore of Arcola lake in sec. 24, tp. 10-3-2. Resurvey of lots 19 and 20 in Fairford settlement, and of blocks 4 and 11 at Wymark, sec. 29, tp. 13-3-3.
Bélanger, P. R. A...	Ottawa, Ont...	Resurvey of part of Lac La Biche settlement. Subdivision in tp. 67-13-4. Correction survey in tp. 67-13-4 and tp. 67-15-4.
Bennett, G. A...	Tillsonburg, Ont...	Stadia surveys in tps. 34 and 35-6-3, tp. 32-13-3, tp. 32-14-3, tp. 31-15-3, tps. 34, 36 and 37-16-3, tps. 31, 32, 33, 34 and 36-17-3, tps. 29 and 31-18-3, tps. 27 and 30-19-3, tps. 27 and 28-20-3, tps. 27, 28 and 29-21-3, tps. 27 to 30-22-3, tps. 27 to 36-23-3, tps. 31 to 36-24-3, tps. 31 to 36-25-3, tps. 31 to 37-26-3, tps. 31 to 36-27-3, tps. 31 to 37-28-3, and tps. 31 to 36-29-3.
Blanchet, G. H...	Ottawa, Ont...	Survey of the east outlines of tp. 37 and part of tp. 38-3-E., tps. 33, 34, 35 and 36-6-E., tps. 29, 30, 31 and 32-7-E., and tps. 27, 28 and part of tp. 26-9-E., and the north outlines of tp. 36-4-E., tp. 36-5-E., tp. 36-6-E., part of tp. 32-6-E., tp. 32-7-E., part of tp. 29-7-E., part of tp. 28-5-E., tp. 28-6-E., tp. 28-7-E., tp. 28-8-E. and tp. 28-9-E.

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SCHEDULE of Surveyors employed and work executed by them—*Continued.*

Surveyor.	Address.	Description of Work.
Boulton, W. J.	Wallaceburg, Ont.	Stadia surveys in tp. 13-15-4, tps. 13 and 14-16-4, tp. 14-17-4, tps. 12, 13 and 14-18-4, tps. 6, 7 and 11 to 14-19-4, tps. 6 to 14-20-4, tps. 7 to 15-21-4, tps. 8, 9 and 12-22-4, tp. 18-28-4, tps. 18, 19 and 24-29-4, and tp. 24-1-5. Retracement in tp. 13-17-4.
Bowman, E. P.	West Montrose, Ont.	Stadia surveys in tps. 45, 46 and 47-10-3, tps. 45 and 46-11-3, tps. 42, 43 and 44-13-3, tp. 51-14-3, tps. 50 to 52-15-3, tps. 50 to 53-16-3, tps. 46 and 50 to 53-17-3, tps. 48, 49 and 51 to 53-18-3, tps. 48 to 52, 54 and 55-19-3, tps. 49 to 55-20-3, tps. 49 to 52 and 54-21-3, tps. 51 and 52-22-3, tp. 51-23-3, tps. 50 and 51-24-3, tps. 49 and 50-25-3, and tps. 49 and 50-26-3.
Brenot, L.	Ottawa, Ont.	Part subdivision of tps. 82, 83 and 84-17-6, tp. 84-22-6, tp. 83-23-6, tp. 83-24-6, and tp. 82-25-6. Survey of the east outlines of tps. 83 and 84-26-6. Traverse in tp. 85-17-6.
Bridglánd, M. P.	Calgary, Alta.	Photo-topographical survey and triangulation in Jasper Park.
Brownlee, J. H.	Dawson, Y.T.	Mineral claim, base line and miscellaneous surveys in the Yukon Territory.
Buchanan, J. A.	Edmonton, Alta.	Subdivision of tps. 91 and 92-20-5 and tps. 90, 91 and 92-21-5.
Calder, J. A.	Lytton, B.C.	Subdivision in tp. 22-21-6, tp. 15-23-6, tps. 15, 16 and 20-24-6, tp. 22-25-6, tps. 19, 20 and 21-26-6, and tp. 18-28-6. Traverse in tps. 15, 16 and 20-24-6, tps. 19, 20 and 21-26-6, tp. 22-21-6 and tp. 22-25-6.
Christie, W.	Prince Albert, Sask.	Subdivision of tp. 53-21-2 and tp. 53-24-2. Part subdivision of tp. 53-20-2, tp. 52-21-2, tps. 53 and 54-22-2, tp. 54-23-2 and tp. 54-24-2. Retracement of the 15th base line across ranges 22 to 27, west of the Second meridian. Survey of Red Rock mineral claim in sec. 21, tp. 49-25-2.
Coltham, G. W. (Owing to illness of Mr. Coltham, charge of party was later transferred to E. S. Martindale.)	Aurora, Ont.	Stadia surveys in tp. 43-28-3, tps. 42 and 43-1-4, tps. 43 and 44-2-4, tps. 43 to 45-3-4, tps. 43 and 44-4-4, tps. 43 to 46-5-4, tps. 43 to 46-6-4, tps. 43 to 46-7-4, tp. 45-8-4, and tps. 44 and 45-9-4.
Coté, J. M.	Ottawa, Ont.	Resurvey of tps. 43 and 44-2-3, tp. 47-22-3 and tp. 27-27-3. Miscellaneous surveys in tp. 41-23-2, tp. 43-27-2, tps. 43 and 45A-28-2, tp. 40-14-3, tps. 30 and 31-21-3 tp. 51-23-3 and tp. 27-28-3.
Cowper, G. C.	Welland, Ont.	Stadia surveys in tps. 17 and 19-7-3, tps. 15 to 19-8-3, tps. 15 to 19-9-3, tps. 15 to 19-10-3, tps. 15 to 18-11-3, tps. 15 to 18-12-3, tps. 16 to 20-13-3, tps. 16 to 20-14-3, tps. 15 to 21-15-3, tps. 12 to 21-16-3, tps. 13 to 17 and 19 to 22-17-3, tps. 9, 10, 12, 14 to 16 and 18 to 22-18-3, tps. 8 to 10, 16 and 18-19-3, tp. 6-20-3 and tp. 6-21-3.
Cumming, A. L.	Cornwall, Ont.	Subdivision of tp. 41-10-5, part subdivision of tp. 41-9-5, tp. 39-10-5, tps. 39 and 40-11-5. Retracement in tp. 40-10-5.
Davies, T. A.	Edmonton, Alta.	Subdivision of tps. 80, 81, 83 and 84-5-6, the west half of tp. 82-5-6 and the east third of tp. 80-6-6.
Day, H. S.	St. John West, N.B.	Subdivision of tps. 81, 83 and 84-6-6.
Deans, W. J.	Brandon, Man.	Inspection of surveys performed during 1915 by Messrs. W. Christie, D.L.S., O. Rolfson, D.L.S., W. A. Scott, D.L.S., and J. W. Tyrrell, D.L.S. Reinspection of contract No. 27 of 1913. Miscellaneous surveys in tp. 5-9-E., tp. 24-6-E., tp. 21-5-Pr., tps. 20 and 21-6-Pr., tp. 20-7-Pr., tp. 18-20-Pr., and tp. 13-13-3. Traverse in tp. 51-26-2.

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SCHEDULE of Surveyors employed and work executed by them—*Continued.*

Surveyor.	Address.	Description of Work.
Evans, S. L.	Corinth, Ont.	Resurvey of tp. 13-27-2. Retracement and subdivision in tp. 15-4-3, tps. 15, 16 and 17-5-3, and tp. 17-6-3. Retracement of tp. 26-8-3, tp. 26-9-3 and tp. 26-10-3. Miscellaneous surveys in tp. 13-26-2, tp. 17-1-3, tp. 32-5-3, tps. 31 and 32-6-3, tp. 25-10-3 and tps. 25 and 26-11-3.
Fawcett, S. D.	Ottawa, Ont.	Subdivision of tps. 77 and 80-16-6, tps. 77, 78 and the eastern two-thirds of tp. 80-17-6. Survey of the east outline of tp. 79-18-6. Stadia surveys in tp. 81-16-6, tp. 79-17-6 and tp. 78-18-6.
Fletcher, J. A.	Fletcher, Ont.	Survey of the 24th and 25th base lines across ranges 1 to 17 west of the Fifth meridian. Resurvey of the 24th and 25th base lines across range 25, west of the Fourth meridian.
Fletcher, W. A.	Thornton, Ont.	Stadia surveys in tp. 26-33-Pr., tp. 26-1-2, tp. 26-2-2, tp. 33-9-2, tps. 27, 31, 32 and 33-10-2, tps. 27, 28 and 32-11-2, tps. 27 and 28-13-2, tps. 27, 28 and 29-14-2, tps. 27, 28 and 29-15-2, tps. 27, 28 and 29-16-2, and tps. 28, 29 and 30-17-2.
Fontaine, L. E.	Lewis, P.Q.	Inspection of survey work performed during 1915 by Messrs. A. E. Glover, D.L.S., A. Lighthall, D.L.S., D. F. McEwen, D.L.S., and H. E. Pearson, D.L.S.
Galletly, J. S.	Oshawa, Ont.	Subdivision in tps. 59 and 60-23-Pr., tps. 58, 59 and 60-24-Pr., tp. 55-27-Pr., tp. 55-28-Pr., tp. 55-29-Pr. and tp. 56-30-Pr. Miscellaneous surveys in tps. 55 and 56-26-Pr.
Gibbon, Jas.	Vancouver, B.C.	Subdivision in tps. 3 and 4-29-6, tp. 3-30-6, tps. 1-and 2, W.C.M., and tps. 7 and 14, E.C.M. Miscellaneous surveys in tps. 17 and 22, E.C.M. Traverse in tps. 3 and 4-29-6, tp. 3-30-6, and tps. 14 and 17, E.C.M.
Glover, A. E.	Edmonton, Alta.	Subdivision of tps. 71 and 72-20-5, tps. 71 and 72-21-5, and part of tp. 72-19-5. Survey of the east outlines of tps. 69 and 70-20-5 and tps. 69 and 70-21-5.
Heathcott, R. V.	Edmonton, Alta.	Subdivision of tp. 85-24-5, tp. 85-25-5, tp. 85-26-5, tps. 83, 84 and 85-1-6, tp. 83-2-6 and the north third of tp. 82-2-6.
Herriot, G. H.	Souris, Man.	Survey of the 15th base line from the NE. cor. sec. 35, tp. 56-4-Pr. to the NE. cor. sec. 35, tp. 56-21-Pr. Resurvey of the 15th base line from the NE. cor. sec. 35, tp. 56-21-Pr. to the Second meridian. Survey of the east outlines of tps. 57, 58, 59 and 60-21-Pr. Survey of the line between Birch Indian reserve No. 27 and tp. 56-20-Pr. and tp. 56-31-Pr.
Hubbell, E. W.	Ottawa, Ont.	Inspection of work performed during the season of 1915 by Messrs. J. C. Baker, D.L.S., R. H. Knight, D.L.S., J. W. Pierce, D.L.S., and W. H. Waddell, D.L.S. Miscellaneous surveys in tp. 91-9-4 and tp. 91-10-4.
Johnston, J. H.	Peace River Crossing, Alta.	Subdivision of tps. 83, 84, 85 and 86-19-5; part subdivision of tps. 82 and 87-19-5 and tp. 84-20-5. Stadia surveys in tp. 83-18-5 and tp. 83-19-5.
Johnston, W. J.	St. Catharines, Ont.	Subdivision in tp. 24-1-6, tp. 23-2-6, tp. 23-4-6, tp. 23-6-6, tp. 22-7-6, tp. 18-8-6, tp. 20-9-6, tps. 18, 21, 22 and 23-10-6, tps. 22 and 23-11-6 and tp. 22-12-6. Traverse in tp. 24-1-6 tps. 21, 22 and 23-10-6, tp. 23-11-6 and tp. 22-12-6.
Knight, R. H.	Edmonton, Alta.	Subdivision surveys in tps. 81, 83 and 84-6-4 and tps. 84, 85, 86, 87 and 88-7-4. Survey of the east outline of tp. 82-6-4. Stadia surveys in tp. 86-8-4.

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SCHEDULE of Surveyors employed and work executed by them—*Continued.*

Surveyor.	Address.	Description of Work.
LeBlanc, P. M. H.	Ottawa, Ont.	Subdivision of tp. 108-5-5, tp. 107-14-5, tp. 106-15-5, tps. 108 and 109-17-5, and tp. 109-18-5. Part subdivision of tps. 102 and 103-9-5, tps. 104 and 109-10-5, tps. 108 and 109-11-5, tps. 108 and 109-12-5, tps. 104 and 108-14-5, tps. 107 and 108-15-5, tp. 108-16-5 and tp. 108-18-5. Survey of the east outlines of tps. 101 and 104-9-5, tp. 101-10-5, tp. 105-14-5, tp. 105-15-5, and tp. 105-16-5. Traverse in tp. 109-13-5, tp. 106-14-5, tp. 106-16-5 and tp. 107-17-5. Survey of Tall Cree Indian reserves Nos. 173 and 173A in tps. 102 and 103-9-5 and tp. 104-10-5.
Lighthall, A.	Vancouver, B.C.	Subdivision of tp. 65-6-5, tps. 63, 64 and 65-7-5, and tps. 61 and 62-8-5. Survey of the east outlines of tps. 63 and 64-9-5
Lonergan, G. J.	Buckingham, P.Q.	Inspection of work performed during the season of 1915 by Messrs. L. Brenot, D.L.S., J. A. Buchanan, D.L.S., T. A. Davies, D.L.S., H. S. Day, D.L.S., S. D. Fawcett, D.L.S., J. H. Johnston, D.L.S., R. V. Heathcott, D.L.S., and G. A. Tipper, D. L.S. Miscellaneous surveys in tp. 81-21-5 and tps. 78, 79 and 80-22-5.
Martindale, E. S. (See G. W. Coltham.)	Aylmer, Ont.	Stadia surveys in tps. 44 to 48-1-4, tps. 43 to 47-2-4, tps. 42 to 48-3-4, tps. 44 to 47-4-4, tps. 46 and 47-5-4, tps. 46, 47, 48 and 54-6-4, tps. 46, 47, 53, 54 and 55-7-4, tps. 46, 47 and 52 to 57-8-4, tps. 46 to 49, 53, 55, 56 and 57-9-4, tps. 48, 49 and 56 to 60-10-4, and tps. 57, 59 and 60-11-4.
McEwen, D. F.	Hensall, Ont.	Subdivision of tp. 72-15-5, tp. 72-16-5 and tp. 72-17-5. Part subdivision of tp. 72-13-5, tp. 71-14-5, tp. 71-15-5, tp. 71-16-5 and tp. 71-17-5.
McGarry, P. J.	Merritton, Ont.	Subdivision in tps. 6 and 7-24-6, tps. 7, 8, 9 and 10-23-6, tps. 8 and 9-22-6, tps. 1 and 2-27-6, tps. 1 and 2-28-6 and tp. 1-29-6. Traverse in tps. 7, 8, 9 and 10-23-6, tp. 2-27-6, tp. 1-28-6 and tp. 1-29-6.
McKay, R. B.	Vancouver, B.C.	Latitude observations in tp. 28-5-E, tp. 16-7-E, tp. 25-9-E, tp. 74-1-Pr., tp. 36-5-Pr., tp. 60-21-Pr., tp. 32-1-2, tp. 32-1-3 and tp. 32-1-4.
McKnight, J. H.	Simcoe, Ont.	Stadia surveys in tp. 33-12-2, tps. 32-33, 37 and 38-13-2, tps. 36 to 39-14-2, tps. 36 to 41-15-2, tps. 37 to 40-16-2, tps. 38 to 41-17-2, tps. 39 and 41-18-2, tps. 34, 35 and 41-19-2, tps. 33 and 34-20-2, and tp. 34,21-2.
McMaster, W. A. A.	Prince Albert, Sask.	Partial resurvey of Prince Albert settlement.
Narraway, A. M.	Ottawa, Ont.	Resurvey of tp. 12-18-3, tp. 22-19-3, tp. 9-20-3, tp. 11-25-3, tp. 13-26-3, and tps. 13 and 14-29-3. Retracement of tp. 16-22-3 and tp. 13-23-3. Miscellaneous surveys in tps. 22 and 23-18-3, tp. 21-19-3, tp. 13-22-3, tps. 12 and 16-23-3, and tps. 10 and 11-26-3. Investigation of the 3rd correction line in ranges 16, 17 and 18, west of the Fourth meridian.
Neelands, R.	Hamiota, Man.	Stadia surveys in tp. 38-21-2, tps. 38 to 40-22-2, tps. 37, 38 and 43 to 45-23-2, tps. 38 and 41 to 45-24-2, tps. 36 to 38 and 42 to 44-25-2, tps. 37, 38 and 42 to 44-26-2, tps. 36, 37, 38 and 43-27-2, tps. 37 and 28-28-2, tps. 43 to 45-1-3, tps. 43 to 45-2-3, tp. 47-3-3, tp. 46-4-3, tp. 44-6-3, tps. 43 to 45-7-3, tps. 43 to 45-8-3, and tps. 44 and 45-9-3.
Norrish W. H.	Ottawa, Ont.	Subdivision in tps. 4 and 6-2-7, tp. 6-3-7, tp. 6-4-7, and tp. 21, E.C.M. Traverse in tp. 6-2-7, Subdivision of villa lots at Woodhaven in fractional tp. W. of tp. 39, W.C.M. Triangulation along Stave lake to locate position of north limit of railway belt.

SESSIONAL PAPER No. 25b

SCHEDULE of Surveyors employed and work executed by them.—*Continued.*

Surveyor.	Address.	Description of Work.
Palmer, P. E.	Ottawa, Ont.	Stadia surveys in tps. 21 and 32-24-2, tps. 21 to 24, 27 and 32 to 34-25-2, tps. 21 to 23 and 25 to 34-26-2, tps. 21 and 28 to 33-27-2, tps. 22, 23 and 28 to 33-28-2, tps. 23, 25 and 29 to 33-29-2, tps. 28 to 30-1-3, tps. 28 and 30-2-3, tp. 24-3-3 and tp. 24-4-3. Miscellaneous surveys in tp. 27-27-2, tps. 24, 25 and 27-28-2, tps. 22, 24 and 28-29-2 and tps. 21 and 27-1-3.
Pearson, H. E.	Edmonton, Alta.	Subdivision of tp. 72-20-4, tps. 72 and 73-21-4 and tp. 73-22-4. Part subdivision of tp. 70-20-4, tp. 73-23-4, tp. 73-24-4 and tp. 73-25-4.
Pierce, J. W.	Pembroke, Ont.	Subdivision of tps. 100 and 101-9-4 and tps. 98 and 99-10-4. Part subdivision of tp. 99-9-4 and tps. 97 and 100-10-4. Correction survey in tp. 91-9-4.
Plunkett, T. H.	Meaford, Ont.	Survey of the 11th base line across ranges 10 to 15, the 12th base line from lake Winnipeg to the NE. cor. sec. 33, tp. 44-16-Pr. and the east outlines of tps. 43 and 44-11-Pr. and tps. 45, 46, 47 and 48-13-Pr.
Purser, R. C.	Ottawa, Ont.	Retracement surveys in tp. 48-22-3, tp. 45-23-3, tps. 20, 52 and 53-1-4, tp. 20-2-4, tp. 31-15-4, tp. 31-21-4 and tp. 31-22-4. Correction surveys in tps. 35 and 36-15-3, tp. 38-16-3, tps. 57 and 58-5-4, tp. 38-8-4, tp. 52-19-4, tp. 55-23-4 and tp. 53-27-4. Miscellaneous surveys in tp. 36-14-3, tp. 43-1-4, tp. 43-3-4, tp. 28-5-4, tp. 39-9-4, tp. 41-12-4, tps. 34, 36 and 53-16-4, tp. 55-22-4 and tp. 53-4-5. Traverse in tps. 61 and 62-27-4.
Rinfret, C.	St. Stanislas, P.Q.	Stadia surveys in tps. 12 and 13-4-2, tp. 13-5-2, tps. 11, 12 and 15-9-2, tps. 11 to 17-10-2, tps. 11 to 14 and 16-11-2, tps. 11 to 15-12-2, tps. 11 to 16-13-2, tps. 11 to 17-14-2, tps. 11 to 17-15-2, tps. 11 to 16-16-2, tps. 11 to 16-17-2, tps. 3 and 11 to 16-18-2, tps. 2 to 4 and 11 to 17-19-2, tps. 4 and 11 to 16-20-2, tps. 13 to 16-21-2, tps. 10 to 16-22-2, tps. 9 to 16-23-2, tps. 11 to 16-24-2 and tps. 10 to 12-25-2. Miscellaneous survey in 9-24-2.
Roberts, O. B.	Kingston, Ont.	Stadia surveys in tps. 23, 31 and 32-29-3, tps. 23 to 28 and 30 to 33-1-4, tps. 22 to 34-2-4, tps. 22 to 27 and 29 to 33-3-4, tps. 23 to 32-4-4, tps. 23 to 31-5-4, tps. 23 to 28-6-4, tps. 23 to 27-7-4, tps. 23 to 27-8-4, tps. 25 and 26-9-4, and tp. 40-22-4.
Rolfson, O.	Walkerville, Ont.	Subdivision of tps. 35, 36 and 37-15-Pr., tps. 37 and 38-16-Pr., tps. 37 and 38-17-Pr. Part subdivision of tps. 34 and 38-15-Pr. Survey of the east outlines of tps. 39 and 40-16-Pr. Stadia survey in tp. 38-18-Pr.
Scott, W. A.	Galt, Ont.	Subdivision of tps. 13 and 14-15-E; and tp. 13-16-E. Part subdivision of tp. 15-15-E and tp. 13-17-E. Traverse in tp. 12-15-E. Stadia surveys in tps. 14 and 15-16-E; and tp. 12-17-E.
Seibert, F. V.	Edmonton, Alta.	Survey of the 27th base line between the Fourth and Fifth meridians. Survey of the east outlines of tps. 103 and 104-9-4 and part of tp. 105-9-4.
Soars, H. M. R.	Edmonton, Alta.	Stadia surveys in tps. 50, 54, 55 and 59-17-4, tps. 50 and 57 to 59-18-4, tps. 49 to 51 and 57 to 59-19-4, tps. 50, 51, 53, 54 and 58-20-4, tps. 48 to 51, 53 and 54-21-4, tps. 47 to 54-22-4, tps. 48 to 54-23-4, tp. 51-24-4, tp. 51-2-5, and tps. 51 and 58-3-5.

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SCHEDULE of Surveyors employed and work executed by them—*Concluded.*

Surveyor.	Address.	Description of Work.
Stewart, N. C.	Nelson, B.C.	Subdivision in tp. 26-15-5, tps. 24 and 25-16-5, tps. 26 and 27-20-5, tps. 24 and 27-21-5, and tps. 27, 28 and 29-22-5. Traverse in tps. 26 and 27-20-5, tp. 27-21-5, tps. 27, 28 and 29-22-5, and tp. 28-23-5. Triangulation and re-tracement surveys in tp. 24-21-5 and tp. 24-22-5.
Street, P. B.	Toronto, Ont.	Part subdivision of tp. 73-2-Pr., tps. 72 and 73-3-Pr., tps. 71 and 72-4-Pr., tps. 70 and 71-5-Pr. and tp. 70-6-Pr. Survey of the east outline of tp. 72-6-Pr.
Stuart, A. G.	Buckingham, P.Q.	Retracement of the 9th base from the Second to the Fifth meridian, the Fourth meridian from the NE. cor. tp. 51-1-4 to the NE. cor. sec. 1, tp. 62-1-4, and the Fifth meridian from the NE. cor. tp. 14-1-5 to the NE. cor. tp. 32-1-5.
Taggart, C. H.	Kamloops, B.C.	Subdivision in tps. 17 and 18-11-6, tp. 17-12-6, tps. 17 and 18-13-6, tp. 19-14-6, tps. 18 and 20-15-6, tp. 22-17-6, and tp. 19-18-6. Miscellaneous survey in tps. 19 and 20-19-6. Traverse in tp. 18-15-6, tp. 19-18-6 and tp. 17-12-6.
Tipper, G. A.	Brantford, Ont.	Subdivision of tp. 77-4-6, tp. 76-6-6, and tp. 77-7-6. Part subdivision of tp. 77-6-6 and tps. 76 and 78-7-6.
Tyrrell, J. W.	Hamilton, Ont.	Part subdivision of tps. 34 and 35-5-Pr., tps. 30, 34 and 35-6-Pr., and tps. 33, 34 and 35-7-Pr.
Waddell, W. H.	Edmonton, Alta.	Part subdivision of tp. 80-6-4, tps. 76, 77 and 78-7-4, tps. 75, 76 and 77-8-4, tps. 73, 74, 75 and 76-9-4, and tp. 73-10-4.
Walker, C. M.	Banff, Alta.	Miscellaneous surveys in tp. 4-10-E., tp. 3-12-E., tp. 18-20-Pr., tp. 3-22-Pr., tp. 16-4-3, tp. 15-5-3, tp. 16-5-3, tps. 18 and 20-6-3, tps. 15 to 18-7-3, tps. 19 and 20-15-3, tps. 10 and 12-16-3, tp. 18-18-3, tp. 18-19-3, tps. 12 and 14-22-3, tp. 11-23-3, tp. 13-28-3, tp. 1-26-4, tp. 22-5-5 and tp. 26-12-5. Levelling contour survey and subdivision of St. Julien addition to townsite of Banff. Miscellaneous surveys at Banff.
Wallace, J. N.	Calgary, Alta.	In charge of precise and other levels, including lines of levels along the G.T.P. railway from Portage la Prairie to Goodeve, and along the C.N. railway from Saskatoon to Rosebud; a line from Grouard through Peace River Crossing to Dunvegan; a line from Desjarlais ferry on North Saskatchewan river to Cold lake, and about 200 miles of short lines and branches from the above.
Weld, W. E.	Ottawa, Ont.	Subdivision in tp. 48-13-Pr. and tp. 48-14-Pr. Survey of addition to Grand Rapids settlement at the mouth of Saskatchewan river.

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APPENDIX No. 2.

SCHEDULE showing for each surveyor employed the number of miles surveyed of section lines, township outlines, traverses of lakes and rivers and resurvey, also the cost of the same. Surveyors whose work cannot be reckoned in miles are omitted from the statement.

Surveyor.	Miles of section.	Miles of outline.	Miles of traverse.	Miles of resurvey.	Total mileage	Total cost.	Cost per mile.
						\$	\$ cts.
Akins, J. R.....		241			241	24,775	102 80
Aylsworth, C. F.....			51	221	272	8,418	30 95
Baker, J. C.....	236	102	133		471	15,701	33 33
Bennett, G. A.....			340	131	471	5,514	11 71
<i>e</i> Blanchet, G. H.....		128		1	129	11,647	90 29
Boulton, W. J.....			564	12	576	5,067	8 79
Bowman, E. P.....			440	34	474	5,695	12 02
Brenot, L.....	265	52	42		359	15,668	43 64
Buchanan, J. A.....	300	54	58		412	14,210	34 49
Calder, J. A.....	138		11	2	151	9,177	60 77
<i>e</i> Christie, W.....	363	53	31	7	454	10,407	22 92
<i>a</i> Christie, W.....				35	35	1,669	47 68
<i>d</i> Coltham, G. W.....			155	12	167	2,020	12 09
Cote, J. M.....				405	405	9,774	24 13
Cowper, G. C.....			294	84	378	5,313	14 06
Cumming, A. L.....	188	37	47	8	280	10,312	36 83
Davies, T. A.....	276	42	27		345	13,285	38 50
Day, H. S.....	240	66	38		344	14,501	42 15
Evans, S. L.....			3	519	522	8,870	16 99
Fawcett, S. D.....	279	42	88		409	14,488	35 42
<i>e</i> Fletcher, J. A.....		204		9	213	28,007	131 49
Fletcher, W. A.....			484	62	546	4,946	9 05
<i>c</i> Galletly, J. S.....	177	53	116		346	11,674	33 74
Gibbon, Jas.....	71		34	37	142	9,049	63 73
Glover, A. E.....	264	74	66		404	14,426	35 70
<i>c e</i> Herriot, G. H.....		126		62	188	14,404	76 61
Heathcott, R. V.....	391	36	28		455	14,303	31 43
Johnston, W. J.....	107		14	19	140	8,874	63 39
<i>e</i> Johnston, J. H.....	340	81	39		460	14,489	31 49
Knight, R. H.....	209	126	46		381	14,269	37 45
<i>b</i> LeBlanc, P. M. H.....	501	198	167	4	870	35,422	40 71
<i>e</i> Lighthall, A.....	360	90	61		511	13,891	27 18
Martindale, E. S.....			294	8	302	3,618	11 98
McEwen, D. F.....	376	62	124		562	13,395	23 83
McGarry, P. J.....	89		44	13	146	10,005	68 53
McKnight, J. H.....			577	8	585	5,479	9 37
Narraway, A. M.....				630	630	10,076	15 99
Neelands, R.....			526	129	655	5,116	7 80
Palmer, P. E.....			238	75	313	5,193	16 59
Pearson, H. E.....	409	44	49		502	13,278	26 45
Pierce, J. W.....	340	126	160	2	628	16,631	26 48
<i>e</i> Plunkett, T. H.....		106			106	16,529	155 94
Rinfret, C.....			182	113	295	4,642	15 73
Roberts, O. B.....			390	92	482	5,642	11 70
Rolfson, O.....	298	72	188		558	13,074	23 43
<i>e</i> Scott, W. A.....	214	46	210		470	13,888	29 55
<i>e</i> Seibert, F. V.....		157			157	21,202	135 04
Soars, H. M. R.....			523	2	525	5,387	10 26
Stewart, N. C.....	64		81	8	153	8,947	58 47
Street, P. B.....	134	50	74		258	8,345	32 35
<i>e</i> Stuart, A. G.....				677	677	9,256	13 67
Taggart, C. H.....	101		2	20	123	9,106	74 03
Tipper, G. A.....	306	30	39		375	14,457	38 55
Tyrrell, J. W.....	254	83	86		423	10,584	25 02
<i>c</i> Waddell, W. H.....	234	144	70		448	14,700	32 81
Total.....	7,524	2,725	7,234	3,441	20,924	628,815	30 05

a Base line resurvey.*b* Includes work of two seasons.*c* Estimate only; final returns not yet in.*d* Taken ill; work taken over by E. S. Martindale.*e* Total cost includes cost of levels.

REPORTS OF SURVEYORS

APPENDIX No. 3.

ABSTRACT OF THE REPORT OF J. R. AKINS, D.L.S.

SURVEY OF THE SIXTH MERIDIAN NORTH OF TOWNSHIP NINETY.

My instructions for the season of 1915 called for the survey of the Sixth meridian from township 90, northerly as far as it could be conveniently run in one season. I accordingly left Edmonton with my party on March 26, and proceeded by train to Reno and thence by trail to Peace River Crossing.

I expected to be able to get the party to the work on sleighs but found the snow all gone, very little frost in the ground, and the ice becoming dangerous on the river. Teams were hired, therefore, to take the party as far as possible in wagons, the route followed being along the Bear Lake and Whitemud River trail. When Whitemud river was reached it was found to be open and we were unable to proceed farther with wagons. The pack-train had therefore to be used for the remainder of the distance.

Work was begun on April 9, but was considerably-retarded for the first week while the supplies were being brought up. Enough supplies were taken along to last for two months; by that time we expected to be far enough north to obtain more at Keg river, where by previous arrangement three months' supplies were being cached. Arrangements were also made to have the supplies for the latter part of the season placed at Hay River post. These were to be freighted from Fort Vermilion over a wagon trail which runs in a northwesterly direction for about one hundred miles to Hay river. This trail is very good for fifty or sixty miles from Fort Vermilion. The remainder is fair, the worst part being around Hutch lake, where it is very stony.

After the first week the work progressed very rapidly and the 27th base was reached on June 21. In 1913 this base had been surveyed to within sixteen miles of the Sixth meridian, and as the closing of the levels on this line with those on the meridian were very much desired it was decided to run the unsurveyed portion of the base line before continuing work on the meridian. This was completed on July 5.

The month of July is always considered by surveyors as the most trying of the year, but this season it was more than usually so for us. From the second crossing of Chinchaga river in township 104, until Negus creek was reached in township 112, a distance of about sixty-five miles, including sixteen miles of the 27th base, only one running creek was crossed and that a very small one. The reason for this was that the season was very dry and the work lay along the divide between the waters of Chinchaga and Boyer rivers. Wells were dug but the water thus obtained was very alkaline. This had a bad effect on both men and horses, as one of the horses died and several of the men became ill.

On August 10, the meridian had reached the 29th base. This base had been run the previous year, but only temporary monuments had been erected across the last range. This range was rerun and permanent monuments were established.

Very little rain had fallen during the summer, and towards the end of July fires began to cause much trouble and annoyance. Large fires were burning to the north, south, east, and west of camp, so that at times the sun was not seen throughout the day because of the dense clouds of smoke, and showers of ashes were continually falling on the camp. This at times made the party very nervous, and on August 9 my cache was burnt. On the 17th the trail locator discovered along Hay river, a large fire which horses could not get through. The party was then camped on a

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small creek in the midst of heavy windfall and long grass, and considerable uneasiness was felt lest the wind should rise and sweep the fire over camp before a trail could be found around it. By making a detour to the west a trail was found around the fire to Hay river, and camp was moved as quickly as possible, but wind had risen the night previous to moving, and although the horses were on the trail about daylight, the fire had already crossed it in several places. As these were not very wide the horses were galloped through them without injury. The same day the line and fire met and the men were compelled to quit work on account of the heat and smoke. The second night after this a light shower dampened the fire sufficiently to allow the line to be surveyed through it and across Hay river. No more fires were encountered, but the smoke was troublesome for some time.

Twenty miles south of Hay river horse feed began to get scarce, and north of township 120 none was to be found. Man-packing was resorted to in order to complete the last twenty-two miles of line.

On October 8, it was decided to quit work on the meridian and turn back, as the season was advancing and there was a long trip home; also the fall appeared to come a month earlier in that latitude than at Peace River Crossing.

It had been our intention, on the return trip, to follow the trail that had been made while producing the meridian, and small caches had been left at intervals along this trail for use on the home trip, but on reaching Hay river we were informed that the country to the south was all burnt, the feed gone, and the trail blocked with windfall. It was therefore necessary to return by the Fort Vermilion trail to where Keg River trail branches from it westward. This is at an Indian village called Alaska, and is about thirty miles west from Fort Vermilion. From this point the Keg River trail was followed to Keg River post. This was much longer than the meridian trail.

On October 21, the day on which the party reached Hay River post, about a foot of snow fell, and it continued to fall in light quantities for several days. We were met at Hay River post by some freighters who had brought supplies in wagons from Fort Vermilion. These were engaged to take the baggage to Alaska, as it was considered advisable to spare the pack-horses as much as possible. The roads were very heavy, however, and as the horses were without oats they gave out after the first day and were sent back. I put ten hundred pounds in one of the wagons, and brought it along with my big team, and what was left was brought by the pack-train.

Alaska was reached on the 28th, and the services of four Indians with their teams were secured to take the outfit to Keg River post. They made very little better time than the pack-train, as they carried no oats for their horses, and these had to "rustle" for their feed in the snow, which in places had attained a depth of eighteen inches. We arrived at Keg River post on November 4, and from there to Peace River Crossing we had to depend on the pack-train. The trail was quite heavy as far as Whitemud river, but south of that the ground was bare. Peace River Crossing was reached on the 17th after thirty-five days of actual travelling from the end of the line. Trail had to be broken for the greater part of the distance through snow from eight to eighteen inches deep. The average distance travelled per day was about twelve miles, which is a good day's work for a loaded pack-train working continuously.

The total number of miles run during the season was 241. Two hundred and eighteen miles of this was on the meridian, which is now surveyed about two miles north of the north boundary of the province of Alberta. Levels and check levels were taken along the lines, and vertical angles were read by the transit from one station to another to check the leveller in case of any large error.

South of Hay river the following method of chaining was adopted: a new device was used by which, during the measuring, the chain was suspended freely; the slope angles were read by the transit; a constant strain was applied which was measured by a spring balance and corrections made for stretch and sag and the temperature of

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each stretch was taken by a Casella thermometer which was fastened to a leg of the tripod. The conditions north of Hay river were not suited to the continuation of this method.

The season's work began at the northeast corner of section 36, township 90, and Battle or Notikewin river was crossed about four and a half miles north. This river is from sixty-six to one hundred feet wide, and from two to eight feet deep. It rises in Clear hills and flows northeasterly into Peace river. It has two large branches, Hotchkiss and Meikle rivers, both of which are nearly as large as the main branch. Meikle river has also a large branch, Botha river. Locally these are all called Battle rivers. Along these streams are some good flats and hay meadows which, in their present condition, would supply feed for a large amount of stock. The soil along the rivers is nearly all suitable for farming but the best flats are found on Notikewin river. About fifteen miles east of the meridian these flats have enlarged to such an extent that they are called the Notikewin river prairie; this is reported to be a fine open piece of country but not very large. The divides between the rivers are low, and generally wooded with spruce, poplar, and willow, but there is very little good timber.

About ten to twelve miles west of the line the country becomes hilly. These hills are a continuation of the Clear hills and extend far to the north forming the divide between Hay and Liard rivers. All the rivers flowing across the meridian, together with Hay river and its tributaries, have their sources in these hills. These hills are reported to be covered with moss and small spruce, the greater part of which has been burnt, and many lakes are located on them. A range of hills also extends across the meridian forming the divide between Notikewin and Keg rivers. It commences about two miles north of township 98, and extends to about the middle of township 101. The summit, which was reached about two miles south of the north boundary of township 98, has an elevation of about 2,790 feet, the highest elevation found during the season. There is very little horse feed on this range.

The line crosses Keg river about the middle of township 101. This stream is about forty feet wide, two feet deep, and flows a little to the north of east, entering Peace river a short distance below Carcajou point. The country is wooded where the river crosses the meridian, but about four miles east of the line Keg River post is located in a beautiful prairie called Keg River prairie. It contains four or five townships of as fine prairie land as one could wish to see, and is exceptionally suited for stock raising, as nowhere in the West does wild vetch and blue-joint grow in greater abundance. Grain cannot be raised very successfully at present because of the frosts. Revillon Frères and the Hudson's Bay company have trading posts at Keg River, and several settlers have squatted there during the past summer. A wagon road runs from the prairie to Carcajou point on Peace river, and also one to North Vermilion. There is much open country along these trails, but the trails are not very good. The wagon road from Peace River Crossing to Bear lake and Notikewin river prairie is now within seventy-five miles of Keg river. When this is cut through, which will probably be in the near future, there will be a wagon road from Peace River Crossing to North Vermilion. A wagon road also leads from Keg River post to Chinchaga river. This river crosses the line about the centre of township 102, and flows northeasterly for several miles, then northwesterly crossing the line again at the southeast corner of township 104. Its farthest point east is about six miles from the meridian. After crossing the meridian the second time it flows in a northwesterly direction until it enters Hay river. There is a good area with fine grass close to the river, but the grass does not extend far back from it. The junction with Hay river is in the vicinity of the 29th base and perhaps twenty miles west from the meridian. This stream is always spoken of by the settlers as Hay river, but is shown on some of the old maps as Chinchaga river, which was the name Mr. Wm. Ogilvie, D.L.S., obtained from the Indians for it when he made the trip in 1891 from Liard river to Fort St. John. I was told by trappers at Fort Vermilion that the Indian name for this river means "big wood," and that it was so named because years ago the country

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along it was wooded with large spruce. Small areas of this timber are still growing on points along the river, but the greater part has been destroyed by fire. Where it is still growing the spruce is the finest that I have ever seen. They have few limbs, and grow very straight to about one hundred feet in height, and taper very slowly from the ground, being nearly as thick fifty feet up as they are four feet from the ground. They were seen up to thirty inches in diameter.

A sketch map, prepared by the British Columbia Government from exploratory surveys, made in 1913-1914, of the northeast portion of Peace River district, shows Hay river as crossing the British Columbia-Alberta boundary about twenty miles south of the 59th parallel of latitude, or about one mile north of township 111. As it crosses the meridian about one mile south of the north boundary of township 114, its general direction is a little north of east. It continues in this direction to Hay River post, after which the course is more north than east. Hay River post is about the north boundary of township 115, and about nine miles east of the meridian. Revillon Frères and the Hudson's Bay company have stores on the south side of the river. These stores open about the middle of October each year, and remain open until spring.

Hay river is quite a large stream during high water, having a width of about 100 yards, and a depth of from four to ten feet, but in the fall the water is very low so that in many places it can be forded with the water not above the knees. A good pack-trail on the north side of the river leads from Hay River post to Adair creek, which it follows for about twelve miles westward from the meridian. From there it swings southwest to Hay lake. Hay river does not run out of Hay lake, but is joined to the lake by a creek. A strip of fine grass land extends along Adair creek: this strip, however, is narrow, and it was the only good country seen north of Hay river.

From Hay river to the northern part of township 120, the country is very level and soft, with numerous bogs, sloughs, and muskegs. The Indians say that somewhere about township 120, and about eighteen miles west of the meridian, there is a large lake, the waters of which flow into Liard river. This would appear to be the same lake that the Nelson Indians told Mr. Ogilvie about, and which they called Bistche lake. The Hay River Indians say that no white man was ever on the lake, and that it takes them from early in the morning until long after dark to go from one end of it to the other with dogs: this would indicate a distance of forty or fifty miles. They also say that in one place it is very narrow with shores of steep solid rock. One of the Indians said he had seen a ribbon of stuff the color of gold running through one of these rocks. It would make a very interesting trip to cross from Hay river to the Liard, as it has never yet been done by a white man.

In township 120 Cutknife mountains were reached. The country rises quickly from the south boundary of the township, which has an elevation of 1,349 feet, to the highest point at the north boundary of township 122 where the elevation is 2,529 feet; this is a rise of about 1,200 feet in eighteen miles. From this point northward the country is level or rolling with an elevation of 2,233 feet at the end of the line.

The water north of township 122 all flows northwestward, probably into Liard river. The top of Cutknife mountains is covered with moss and a growth of stunted spruce. The age of one of these spruce that had a diameter of about four inches, was found to be 133 years. The frost in many places never goes out of the ground, the moss preventing the heat from entering the soil. Below the moss is gravel.

There are many lakes in this district some of which are of considerable size. Beatty-lake which is just west of the meridian in township 125, is about six miles long and about four wide. These lakes have stony bottoms and shores, and contain many fish.

The Indians living around Hay river belong to the Slavey tribe. They cannot understand Cree nor can a Cree Indian understand their language. Near the end of the line a hunting party of Indians from Providence was seen.

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There are many bears, moose, jumping deer, and caribou in the country passed over during the season. The best hunting ground is on Notikewin river and its tributaries. The caribou live north of Hay river. It appears that in the past, game was much more plentiful north of Hay river than now, as there are numerous paths that have been cut deep in the moss. The burning of the country has had much to do with scattering the game. There are many fur-bearing animals along the country travelled over and Hay River post is considered one of the best fur posts the trading companies have. Very few grouse were seen, but there were many geese and ducks on the rivers and lakes.

There was no rock found in place nor any mineral.

APPENDIX No. 4.

ABSTRACT OF THE REPORT OF C. F. AYLSWORTH, D.L.S.

MISCELLANEOUS RESURVEYS IN MANITOBA AND EASTERN SASKATCHEWAN.

On April 29, I left Winnipeg with my party and proceeded to tp. 12-9-E, where we resurveyed the north boundary of the township. The northern part of this township is mostly sand and gravel and is of little value as agricultural land. A good wagon road leads from Molson to the northeast corner of section 34.

We next moved into tp. 12-10-E., to complete the retracement of the western part of the township left unfinished in 1914; this was completed on May 19. Sections 11, 12, 13, and 14 of this township also required retracement but Julius muskeg in the centre of the township was found to be impassable for wagons or horses. We therefore returned to Molson and secured a hand-car, which we used on the Canadian Pacific railway for travelling back and forth to these sections. This work was completed on the 26th.

Our next work was the retracing of that part of tp. 26-30-Pr., lying north of Assiniboine river. These sections lie principally along the edge of the river valley, and the work was consequently rough. The land in the bottom of the valley is very rich and easily cleared.

On June 17, we moved to tp. 23-31-Pr., where all the lines in the township were retraced. There are a few Icelanders in this district, but most of the settlers are Germans. They appear to be fairly prosperous, although a number of the homesteads have been abandoned. The greatest drawback is the difficulty of obtaining water.

On July 17, this survey having been completed, we proceeded to section 3, tp. 29-31-Pr., and from this place as a camp we retraced the north boundary of tp. 28-31-Pr., and the boundaries of several sections adjoining this line. There are two Doukhobor villages in the section where our camp was located, but only about half of the houses in these villages are now occupied, as many of the people are living on their own homesteads. They are erecting substantial buildings and are quickly becoming Canadianized.

On August 30, we began the retracement of the west halves of tps. 24 and 25-27-Pr. These half townships lie just west of Riding Mountain Forest reserve, and have been overrun by fire many times. They are covered with a thick growth of peavine, and would appear to be well suited for mixed farming. Although only recently thrown open for settlement, they are nearly all homesteaded. The main line of the Canadian Northern railway crosses the northern part of township 25.

On completion of this survey I broke camp, stored my outfit, and left for home, where I arrived on October 9.

APPENDIX No. 5.

ABSTRACT OF THE REPORT OF J. C. BAKER, D.L.S.

SUBDIVISION SURVEYS IN NORTHERN ALBERTA.

The work upon which I was engaged during the season of 1915, was confined to the lands along Athabaska river, in township 94, range 10, and townships 94, 95, 96, and 97, range 11, all west of the Fourth meridian.

I left Edmonton with my party on May 7, and arrived at the mouth of Muskeg river, in tp. 94-10-4, on May 21. The route followed was by rail to Athabaska, and thence down Athabaska river by 'scows to our destination.

Work was commenced on May 22, and was completed, with the exception of the traverse work, on October 27. My assistant then took the majority of the party to Edmonton, where they were discharged. Five men were retained to assist with the traverse, which was completed on December 3.

The district surveyed is fairly level, with the exception of the valleys of Muskeg, McKay, and Moose rivers. These valleys vary from fifty to two hundred feet in depth, and the sides of the valleys of the two latter streams are so steep as to render the rivers of little use as sources of water supply for stock.

A cross-section of the country six miles, east, and six miles west of the Athabaska, in almost any part of the district surveyed, would show about two and a half miles of fairly level, lightly-wooded land, two miles of muskeg, sometimes very wet, and back of that higher land covered with second-growth poplar and willow. When cleared and drained most of the land in the district will be suitable for agriculture. The Indians at McKay grow garden vegetables with very little labour. There is no hay-land in the district, but the muskeg will grow plenty of hay when the moss is burned off, as the soil beneath the moss is sandy loam. Large deposits of asphalt occur along the various streams in the district.

Game is quite plentiful, consisting of moose, bears, and a few deer, while fur-bearing animals, such as marten, foxes, mink, and beavers are also quite numerous.

It is expected that the new Alberta and Great Waterways railway will be completed as far as McMurray early in 1916, and this will save settlers and other travellers a hard trip by scow. Beyond McMurray the river is clear of rapids and is suitable for navigation. Last summer one or two passenger boats made monthly trips between McMurray and Chipewyan. There is a good pack-trail on the west side of the river leading from McMurray to McKay.

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APPENDIX No. 6.

ABSTRACT OF THE REPORT OF M. H. BAKER, D.L.S.

MISCELLANEOUS SURVEYS IN MANITOBA, SASKATCHEWAN AND ALBERTA.

The work on which I was engaged was of such a varied and scattered nature that no regular party was organized, labourers being hired locally when needed.

Our first work was the survey of a parcel of land in tp. 15-12-E. as a site for power development for the Winnipeg Electric Railway Co. The surrounding area is wooded with poplar, spruce, balsam, and birch, and although there is considerable rock, good areas of agricultural land are interspersed. Winnipeg river has been so much deepened and cleared of rock cuts by power development works that the increased flow of water in Pinawa channel has flooded large flats of land which are now permanently covered with water.

The district along Swan river in tp. 37-26-Pr., where we made a correction survey, is partly wooded and the soil is very fertile. It is well settled and grain is the chief product.

After making a correction survey in tp. 51-3-3 and also in tp. 40-26-2 we left for Watrous, Saskatchewan to resurvey the 8th correction line across ranges 26 and 27.

In this district which is practically all taken up, wheat is raised extensively and also a considerable quantity of oats. It is close to the Canadian Pacific railway and transportation is good. Across range 26 the surface is rolling and increases in roughness until it becomes hilly on the west side of range 27, but it is not too rough for farming purposes. The land throughout this district is rather stony but the soil is of excellent quality after the stones are cleared off.

We next made corrections in tp. 27-24-2 and tp. 24-24-2 and subdivided the dried-up bed of a portion of Last Mountain lake in tp. 22-23-2. The land in this district is excellent, and large areas of wheat and oats with some flax are cultivated. Good crops are obtained every year without exception. Last Mountain lake abounds in whitefish, pickerel, and perch, and the fishing industry is being extensively developed. This district appears exceedingly prosperous.

A resurvey of blocks 4 and 11 in the townsite of Wymark, Saskatchewan, was next made and we then went to Outlook, Saskatchewan, arriving there on July 5, to make a resurvey of the E. By. sec. 13, tp. 28-7-3. This district is well developed, practically all the land being under cultivation and producing excellent crops of wheat and oats, and other grains in small quantities.

We next proceeded to Dana, Saskatchewan, where a small correction was necessary in sec. 20, tp. 38-26-2, and from there to Gilbert Plains, Manitoba, where I investigated an erroneous monument marking the quarter-section corner on the E. By. sec. 10, tp. 25-22-Pr. The latter is a very old-settled section of the country and practically all the land in the vicinity is occupied. Much of it is cleared and produces excellent crops of wheat and oats. Some mixed farming is also carried on.

From Gilbert Plains, we proceeded to Ste. Anne des Chenes, Manitoba, to survey that portion of the Dawson road extending from the east boundary of Lot 94, in the parish of Lorette to the east boundary of tp. 8-8-E. Much of this road, where surveyed, has been graded, and I understand it is the intention to grade those portions which have not already been done. Through the parish of Ste. Anne des Chenes, the lots are all settled and large areas are cultivated, wheat and oats being the chief products. There are also large areas of hay lands. Between the east boundary of the parish of

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Sté. Anne des Chenes and the east boundary of township 8, range 8, much of the country is still unoccupied and is densely wooded. A few farms have been cleared, however, and good crops are raised.

I completed the survey of the Dawson road on August 16, and proceeded to Fairford, Manitoba, where I retraced lots 19 and 20 in Fairford settlement and restored lost monuments. These lots are surrounded by Fairford Indian reserve. In the surrounding country there has been very little development, most of the country being thickly wooded.

From Fairford I went to St. Laurent, and from there drove to tp. 15-4-Pr. In this township I was instructed to survey all agricultural land in sections 29, 30, 31, and 32, which had not already been surveyed. The land in these sections consists of a narrow neck separating lake Francis on the east from lake Manitoba on the west. It is bordered on the west side by a good sandy beach rising to sand dunes, and on the east side by large areas of marsh. We found but a very small area of land fit for agriculture and that was of very poor quality.

Our next work was in township 17-11-E., where we retraced several lines. This township is so thickly wooded and crossed by a number of rock ridges that no settlement has taken place yet. We then proceeded to tp. 4-17-Pr. to investigate duplicate monuments along the north boundary of section 26. This district is practically all under cultivation, and produces crops of wheat and oats principally.

The survey of a road along the north shore of Arcola lake in sec. 24, tp. 10-3-2 was our next work. This road is located in the Moose Mountain Forest reserve, Arcola lake is rapidly developing into a popular summer resort, and a number of summer residences are already built. The road from Arcola is in very bad condition and in wet weather is almost impassable for motor cars.

From Arcola, we proceeded to Huntoon, Saskatchewan, in tp. 7-10-2 where we had instructions to correct a number of erroneous monuments. This district is well settled but much of the land is held by speculators and is still unoccupied. Excellent crops are raised, chiefly of wheat and oats, but very little mixed farming is carried on.

We next proceeded to Estevan, arriving there on October 3; from there we drove to townships 1, ranges 8 and 9, west of the Second meridian where we retraced the line between ranges 8 and 9 in townships 1 and 2. Township 1 in these ranges, is well settled and large areas are under cultivation. During my visit in the district, threshing operations were being diligently prosecuted, and the yield of wheat was found to average about forty bushels per acre. The farmers in the vicinity of the international boundary ship their wheat in bond from stations on the American side of the line to Canadian ports, as they contend the roads are better for the heavy loads than the roads to Estevan. In township 2 in these ranges, the land is exceedingly rough and stony, so that very little settlement has taken place and practically no land is cultivated.

We next made a resurvey in tp. 28-18-2 and tp. 24-2-2, surveyed a cemetery at Willowbunch in tp. 5-27-2, and made a correction survey in tp. 19-8-2.

Our last work was the survey of part of tp. 44-25-Pr. This is a very difficult section of the country to reach except in winter as the trail from Mafeking crosses very wet muskeg country. There is very little land of agricultural value in this vicinity. At the mouth of Steep Rock river there is a permanent fishing camp where operations are carried on in the winter. Completing this work I left for Mafeking on October 31 and thence for my home in Toronto.

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APPENDIX No. 7.

ABSTRACT OF THE REPORT OF P. R. A. BELANGER, D.L.S.

RESURVEY OF LAC LA BICHE SETTLEMENT IN NORTHERN ALBERTA.

Arriving with my party at Lac La Biche on June 25, we immediately began an investigation to ascertain whether or not a resurvey of the settlement was necessary. This was done on our way from the railway station to the west end of the settlement, a distance of about twenty miles. It was soon ascertained that a resurvey was urgently required, and work was started at once.

The original survey of the settlement had been made twenty-seven years ago and the old wooden posts were all rotted off. None of the settlers seemed to know the position of any corner or line, and it required several days' work on our part to locate a lot monument from which to start our resurvey. However, after getting a proper start we had little difficulty in finding the remains of the old posts. Seventy-five per cent of these were found, although not showing on the surface. In some cases the tops of the posts could be found lying on the ground and covered with several inches of rotted leaves or other vegetation, while in other cases only the bottoms of the posts could be found. These were usually from six to eighteen inches below the surface. In some cases old bearing trees were detected by small blisters on their sides. These blisters when reopened showed the old blazes with the letters B.T. well preserved in most cases, and at depths varying from one to three inches in the trunks of the trees.

We did not consider it necessary to retrace lac La Biche as there had been practically no change in the shore line since the original survey. All small lakes within the settlement were retraversed, however, and all lot lines were retraced with the exception of the boundaries of lots 4, 5, and 6, which had been resurveyed several years previously. Only part of the trail through the settlement was retraced. All old wooden posts were replaced by iron ones, and the mounds were rebuilt. We also surveyed a few miles of section lines in the adjoining townships.

This work kept us busy till October 13, when we returned to Edmonton where the party was disbanded.

The settlement has been gradually going backward for the past ten years, because most of the settlers, after receiving their patents, sold their land for a few dollars to speculators, who hold it now at exorbitant prices. They do not cultivate the land, and the houses and buildings are closed and are falling to ruin. This condition cannot last very long however, as the construction of the railway is already bringing new life to the eastern part of the settlement, where the station is located. Townsites have also been laid out upon which a thriving little town is already rising, with stores and shops of all kinds. A fine hotel owned by the railway company, was nearing completion last fall; it is built in the most modern style, with the intention of supplying first-class accommodation, and making Lac La Biche an attractive place for tourists, who will find there one of the most ideal summer resorts in the province of Alberta. All along the lake are found ideal places for summer residences with fine sandy beaches, which in some places extend for a quarter of a mile into the lake, the depth of water increasing very gradually from one to four feet and affording the greatest safety for bathers. One steamboat and several gasoline and sail boats are already plying over the lake, and are kept in readiness for prospective tourists, who are expected to visit the place or make their summer homes there.

The richness of the land and the ideal climate which prevails at Lac La Biche, should make the settlement an attractive place for settlers willing to invest money on

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paying farm land. They would find a ready market for their products, either by selling them to the numerous tourists who will adopt that place for their summer homes, or by supplying the northern districts extending to the Arctic ocean.

The railway is expected to be completed to McMurray this year and it should prove a great boon for the Edmonton district, which will benefit by the opening of that country to agriculture and the lumber trade.

Sportsmen will be afforded a great opportunity to enjoy good hunting and fishing excursions. They can go to McMurray by rail, and from there by canoe to any place down Mackenzie river, and return by canoe or steamboat to Peace River Crossing.

Small and large game is decreasing every year in this district. Large game is now found on the north side of the lake only. Whitefish, pike, and pickerel are still plentiful.

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APPENDIX No. 8.

ABSTRACT OF THE REPORT OF G. A. BENNETT, D.L.S.

STADIA SURVEYS IN SOUTHERN SASKATCHEWAN.

My surveys for the season of 1915 consisted of the investigation and survey of water areas within the block of townships between the 7th correction line (north of township 26) and the 10th base line (north of township 36), and between ranges 16 and 29 inclusive west of the Third meridian.

I left home on May 21 and proceeded to Saskatoon where I organized my party. Field operations were commenced on May 28 in tp. 36-16-3.

In this township and those adjacent to it, many alkaline lakes were investigated and surveyed. These water areas varied from ponds just over five acres in extent to large lakes from twelve to fifteen miles in length and three to four miles in width. The depth of these lakes does not usually exceed eighteen inches, and the water usually consists of a liquid alkaline solution of hydrous sulphate of sodium, sodium chloride, and magnesium sulphate. Under this is a semifluid alkaline mud varying from three to twelve feet in depth. During periods of drought the shores become encrusted with a white efflorescence of the salts held in solution. This prevents the growth of vegetation and maintains the area of the lakes fairly constant from year to year, although they have their main source from surface drainage and have no outlet except evaporation.

The soil in this district is generally sandy or sandy loam. Almost all the land has been homesteaded and the settlers are making a success of mixed farming.

When the investigation had been completed of all the townships in the vicinity of Biggar, not previously examined, the work was continued west of Kerrobert. From June 23, until September 27, the party was engaged in the block of forty-two townships composed of townships 31 to 36, ranges 23 to 29. Many lakes were found and surveyed, almost all of which were alkaline or salty. Very few of these lakes had been previously surveyed as their area seldom exceeded twenty acres, while numerous large lakes which had been surveyed some years ago were found to have dried up, leaving their beds available for hay and pasture land. The section lines were run across these dry lake beds and monuments were erected at the section and quarter-section corners.

Three small resurveys were also made to correct errors found in the original survey of the section lines in tp. 36-24-3, tp. 36-26-3 and tp. 34-28-3.

During the summer of 1914 the crops suffered so severely from drought that very little grain was harvested and many of the settlers were threatened with ruin. The Dominion Government however came to their rescue and loaned them feed and seed grain which enabled them, not only to winter their stock, but also to sow a greater acreage in 1915. Evidence of this could be seen in the fine herds of cattle grazing in the sloughs, the quantities of dairy produce shipped by the farmers, and the large crops of wheat and oats harvested.

Our next work was in seven scattered townships, northwest of Zealandia. These townships contained very little water: only one lake was found, and the marshes and sloughs that had existed at the time of the original survey were found to have dried up, so that it was possible to erect monuments to mark the section and quarter-section corners that fell in these depressions. These townships were found to be well settled, and about half the land is under cultivation.

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On October 13 we began the investigation and the necessary survey of a block of sixteen townships near the town of Kindersley on the Saskatoon-Calgary branch of the Canadian Northern railway. Almost all the water areas that existed in these townships at the time of the original survey had dried up, so that we were able to establish many monuments to mark section and quarter-section corners. These townships were in what is known as the "Goose Lake" district. This district, famous for its grain growing, broke all former records in 1915, and yields of from forty to sixty bushels of wheat, and from ninety to one hundred and twenty bushels of oats, to an acre were harvested. The grain was of excellent quality, and the quantity was so great that the Canadian Northern Railway Co. was unable to provide cars in sufficient numbers to move the crop. Some farmers built granaries of huge bins, others merely piled the grain upon the prairie. North of Fiske station we saw one such pile, from the crop of a single farmer, which was estimated to contain seventeen thousand bushels of wheat.

We next moved to tp. 35-6-3 where a traverse of South Saskatchewan river through the township was urgently required. The new survey showed that the river had altered its course very considerably since the previous survey. On the east boundary of section 11, a strip of good bench land nine chains in width had been washed away. Some difficulty was experienced in making the survey of the river at that season of the year on account of the dense willow brush which covered the banks and islands, and the treacherous quicksand found along the water's edge. On this account only the surveys urgently required were made. The party was disbanded on November 5.

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APPENDIX No. 9.

ABSTRACT OF THE REPORT OF G. H. BLANCHET, D. L. S.

BLOCK OUTLINE SURVEY EAST OF LAKE WINNIPEG.

Leaving Selkirk on May 13 we went by boat to Berens and then by canoe to our starting point on Pigeon bay. We began work at the NE. cor. tp. 37-3-E. on the 17th and ran south to the 10th base line (north of township 36). We next ran the 10th base east across ranges 4, 5 and 6, and then surveyed the east outline of range 6 south of the 9th base line (north of township 32).

The east outline of tp. 37-3-E cuts off Pigeon point, the southeast corner of the township lying on the shore of lake Winnipeg. From there a heavy growth of spruce, tamarack and jack pine extends along the 10th base line for six miles east, but beyond that the timber has been burned off and muskegs are more extensive.

Pigeon river crosses the base line near the east side of range 5. It is one of the largest streams of the district, having a discharge of about 1,500 cubic feet per second. It has its source, in common with Berens river, in a series of lakes near the Ontario boundary. It is navigable for canoes throughout its length, but there are many portages around its numerous rapids and falls. There are several good water-power sites near its mouth, the best being that known as Sturgeon falls where there is an abrupt drop of about eighteen feet.

The 9th base line was extended west to connect the levels with lake Winnipeg. The water level in the lake, during the past years, as marked on the rocks, along the shores, shows the lake to be lowering, and it was reported that hay was being cut at the mouth of Bloodvein river in sloughs which had always been too wet before. The base line was also extended east through range 7.

The east boundary of range 7 was next run from the 9th to the 8th base line (north of township 28). Bloodvein river crosses this line near the correction line, and flows northwesterly entering lake Winnipeg near the 9th base line. It rises in lakes and muskegs to the east, discharges about 1,000 cubic feet per second, and like the other rivers of this district its fall comes in abrupt drops over rock ridges where water-power could be developed. About four miles north of its crossing of the line it is joined by Leyond river, coming from the northeast. There is a water route by way of the latter stream through to Pigeon river.

Loon creek which flows along the north boundary of township 29 has some good timber along its course near the lake, and in the vicinity of its mouth there is some good hay land. Some half-breed settlers in that vicinity keep a considerable number of cattle.

The 8th base line was extended westerly to the lake and connected by means of a system of triangles across the lake with the portion of the base line which has been run easterly from the Principal meridian. As both shores of the lake were low, and the distance across about thirteen miles, a direct triangulation was impossible, and it was necessary to use Berry island, which is about half way across and one and a half miles south of the line. The levels were also connected by means of the lake with those of the base line on the west side.

We extended the 8th base line east through ranges 8 and 9, and then turned south again along the east boundary of range 9, where a closing was made with the earlier surveys to the south in township 26. This line passed about one mile east of Rice lakes. These are several small lakes joined by narrows in which wild rice grows very

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luxuriantly, sometimes being six or eight feet high. Near the lakes there has been a good growth of spruce, most of which has been cut some years ago. Rice river flows from these lakes into lake Winnipeg.

In the district east of lake Winnipeg the granite bedrock is not far from the surface, outcropping frequently in scarred domes, on which glacial action is recorded by striations and smooth grooves. The weathering of these rocks has produced but scanty soil, indicating their recent emergence from the waters of original "Lake Agassiz". The areas between the islands are usually of a level lake bottom nature. The rocky prominences drain rapidly into the surrounding silt-filled basins where the underlying rock prevents absorption, and from its level nature surface flow is slow and also much retarded by natural rock dams, consequently the land around the rock outcrops is usually swampy but the soil is good.

The rivers are uniform and have little current except where they are broken by rapids in crossing ridges of rock. Good water-power sites are numerous, and some good agricultural land lies near the streams.

The timber is mostly small as the surface has often been fire-swept during dry years, but some isolated patches of merchantable timber are yet found along the lakes and rivers. Timber suitable for pulpwood is plentiful, and the numerous water-power sites and cheap transportation on lake Winnipeg should make paper manufacturing a profitable industry.

The minerals of this district are perhaps its most valuable asset. Gold has been discovered in the vicinity of Wanipigow river and the formation of the country points to the possibility of its being rich in minerals. Prospecting is difficult however on account of the moss generally covering the rock and the extensive swamps. The mining industry would be greatly assisted by cheap power and transportation.

Agriculture except in the proximity of the lakes and rivers, can not be followed till drainage on an extensive scale is done, but the soil should prove fertile. Hay is scarce and the long winter and lack of shelter render this district unsuitable for ranching.

Fish are plentiful in lake Winnipeg and the rivers running into it, and the fishing industry furnishes employment to the people living along the lake.

Game is abundant back from the lake and easy access is furnished by the rivers.

The work was completed on September 1, and the party left for Selkirk where it was disbanded on the 3rd.

APPENDIX No. 10.

ABSTRACT OF THE REPORT OF W. J. BOULTON, D.L.S.

STADIA SURVEYS IN THE LETHBRIDGE DISTRICT.

From Lethbridge, where I organized my party, we left for tp. 8-21-4, where our first investigation was made. After completing the work in this vicinity we moved south to tp. 7-19-4 and tp. 7-20-4, both of which we investigated.

The surface in this district is rolling and the lakes which are fairly numerous are very shallow, being not more than three or four feet deep. Sterling lake, or as it is locally called "Eighteen-mile" lake, has a very indefinite and variable shore line. The water level is entirely dependent upon the amount of surplus irrigation water which finds its way into the lake on its southerly side. This district is sparsely settled and is used almost exclusively for grazing.

The next work was the survey of St. Mary river and other water areas in tp. 7-21-4.

This river is rather winding in its course and has a current averaging three miles an hour. Its bed is about 250 feet wide, and the valley through which it flows is about 200 feet deep and 1,300 feet wide. This township is fairly well settled in its southerly and westerly parts, and a considerable amount of wheat and rye is grown there. The yield during the past season was excellent. There are a number of small coal mines operating in the valley of St. Mary river, which supply an ample amount for local consumption.

We next moved to the vicinity of Lethbridge, and commenced the survey of Oldman river, where it first crosses the east boundary of tp. 8-22-4.

In tp. 8-20-4 and tp. 8-21-4 as well as tp. 9-20-4 and tp. 9-21-4 a considerable amount of irrigation has been done and good crops of alfalfa, wheat, and oats are grown each year. The farmers also raise quite a number of hogs and cattle.

On July 30 we moved camp to tp. 9-21-4 and continued the survey of Oldman river through tp. 9-22-4 and tps. 9 and 10-21-4. There are some excellent coal mines in operation along the valley of Oldman river in tp. 9-21-4, viz. at Stafford Village and Hardieville, and during the past season a full complement of men have been engaged. The mine at Hardieville finds a market in Saskatchewan for its entire production.

Oldman river, like St. Mary river, pursues a very winding course and many nice flats are available on the inner curves of the river, the opposite sides at these points being cut banks about seventy-five feet high. The valley through which it flows varies from one-quarter to one-half mile wide. The area occupied by the bed of the river is from 400 feet to 600 feet wide, this being smaller than it was at the time of the original survey. This is no doubt due to the immense amount of water that is now being taken from St. Mary river, which is a tributary of the Oldman, to supply the needs of irrigation. Consequently, there is considerable tree plant vegetation found along and on what used to be called "Sandbars".

After completing the survey of Oldman river across tp. 11-19-4, we surveyed Little Bow river across the same township. This stream is small, being about seventy-five feet wide, and receives its main supply of water from Highwood river, to which it has been artificially connected in tp. 18-29-4. That part of the township west of the Little Bow is under cultivation, and produced a good substantial yield during the past season.

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The townships farther north are well settled and good crops were secured this year as the moisture was sufficient. More oats are grown than farther south, where the raising of wheat is the staple industry. Stony sections are numerous and although this land is unfit for agriculture it is used for grazing, as it produces fairly good grass. Water is scarce and what can be secured from wells from seventy to eighty feet deep is mostly alkaline.

Many irrigation works are in process of construction but the lack of railroads will prevent farmers from marketing their grain.

After completing the work in the Lethbridge district, I moved to tp. 24-1-5 to traverse Bow and Elbow rivers across the township, and I also surveyed the Canadian Pacific Railway Company's irrigation canal and Nose creek in the same township. Bow river varies from 400 to 500 feet wide and has a current of three miles per hour. It is used by lumbermen for driving logs to the mills in Calgary.

On October 26, I closed operations and discharged the party.

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APPENDIX No. 11.

ABSTRACT OF THE REPORT OF E. P. BOWMAN, D.L.S.

STADIA SURVEYS IN THE BATTLEFORD DISTRICT.

The stadia surveys on which I was engaged during the past season were in a block of about twenty townships north of Battleford.

The party was organized at Battleford and we left there on May 28 for our first work in tp. 43-13-3.

In addition to the stadia traverses of lakes, a number of section lines were retraced and monuments established at places where bodies of water had dried up since the original survey. This work, however, was only done in those townships where the amount of such work was not so great as to delay the stadia work unduly.

In the northerly part of this district, the outlines of the lakes previously surveyed have not changed much, though generally speaking, they appear to be getting somewhat shallower, which is shown by the receding of the shore line in the shallower parts. In the southerly part of my work, the change in the lakes is more marked, some being very shallow and these will probably dry up entirely in a few years, while others remain practically unchanged. A number of new lakes were also found in the district investigated this season, especially in the more northerly townships. The season of 1915 has been exceptionally dry in this district, so that the lakes are lower than they have been for some years.

The greater part of this area is settled fairly well excepting railway lands, several of the northerly townships being practically the north limit of the country where the homestead lands are mostly taken up. The surface is mostly rolling with bluffs of poplar and willow, becoming thickly covered with poplar, willow, second-growth poplar and windfall in places towards the northerly townships. Spruce, tamarack and jack-pine are also found in some of these north townships.

Most of the lakes are shallow and are only the result of surface drainage. They are drying up every year as the land is cultivated, and it is only a question of time till the most of them will entirely disappear. In many of these lakes the water is alkaline.

Hay lands are not plentiful but scattered patches are found, and grass grows in many places. The district was formerly a ranching area but it is now taken up as homesteads, although almost fifty per cent of the land is owned by companies and speculators on which there are no settlers.

Transportation facilities are poor as there are no railways and but few graded roads. For this reason many settlers have left the district even after securing their patents.

Timber for building purposes is plentiful and the settlers have taken advantage of this by erecting good houses and outbuildings.

Mixed farming is the principal industry and only enough grain is grown to feed the stock raised as shipping facilities are poor.

Muskrats are the only fur-bearing animals at all plentiful in this district, and some of the settlers engage in trapping these in the winter months. Many Indians engage in trapping around the lakes in this district, especially in the northern part. Coyotes are fairly numerous though not as numerous as on the prairie. Moose and deer are occasionally seen in the northern townships as far south as township 51. Ducks and geese are plentiful and prairie-chickens are fairly numerous in the better settled and more open districts, while partridges are occasionally seen in the wooded parts.

Fish are found in a number of the lakes in this district, particularly in Birch lake, Turtle lake and Jackfish lake. Winter fishing is carried on quite extensively on Turtle lake, jackfish and whitefish being the principal kinds caught.

APPENDIX No. 12.

ABSTRACT OF THE REPORT OF L. BRENOT, D.L.S.

SUBDIVISION SURVEYS IN THE PEACE RIVER BLOCK, BRITISH COLUMBIA.

My work for the season consisted of the subdivision of lands already settled, or suitable for settlement, in the vicinity of Peace river in the Peace River block. As most of the bench and bottom lands along the river had been previously surveyed my work was confined chiefly to the many plateaus on the north side of the river.

My party left Edmonton on May 7, 1915, and travelled by rail to Reno, which was at the time the end of steel on the Peace River Crossing branch of the Edmonton Dunvegan and British Columbia railway. From there the outfit and supplies were freighted to Peace River Crossing, where we waited until May 17, when the Hudson's Bay Company's steamer made its first trip up the river. We arrived at Hudson Hope on the 21st.

Our first work was in tp. 82-25-6, where we completed that part of the township not already subdivided. We then subdivided the southerly two-thirds of tp. 83-24-6, that part of tp. 83-23-6, north of Peace river, and the southerly one-third of tp. 84-22-6. We were very much hindered in tp. 83-23-6, by the precipitous banks of Halfway river which are from 700 to 900 feet in height. This stream was also very much swollen by heavy rains at the time of our survey.

On completion of these townships we constructed a raft on which we floated down the river to Taylor's landing in tp. 82-18-6, where we were met by the pack-train which had been sent overland. From this camp as our headquarters we subdivided the northerly one-third of tp. 82-17-6, all of tp. 83-17-6, and the northerly two-thirds of tp. 84-17-6.

Our survey operations were brought to a close on October 4, and on the following day we started for Peace River Crossing on our raft. We arrived back in Edmonton on the 14th.

The homesteading and farming prospects throughout the various parts surveyed are, for the most part, very encouraging. The surface is mostly rolling or undulating and in some places heavily timbered, but more often with alternate patches of prairie and poplar bluffs. The soil is fertile, and the growth of different kinds of grasses is very luxuriant. Hay sloughs are numerous, and many of them contain a permanent supply of good water. The whole district surveyed seems well suited for stock raising, and as there are many extensive tracts of nearly open country, farming could be carried on successfully without much additional clearing.

It is now comparatively easy to reach this district by the Edmonton Dunvegan and British Columbia railway, which was expected to be completed to Peace River Crossing by November 15, 1915. By the old winter trail the journey from Edmonton to this point usually took two weeks; it can now be accomplished in one day by train. In the summer, from the middle of May to the beginning of September, two steamers, of a capacity of fifty to sixty tons each, ply the river between Hudson Hope and Fort Vermilion, a distance of over 500 miles. Several large gasoline boats also made numerous trips last summer, carrying both passengers and freight. Two other boats of a greater capacity than any on the river at the present time, are under construction at Peace River Crossing, and will be launched in the spring, so it can reasonably be expected that the freight rates for next season will be reduced considerably. The winter route is also much improved. It is expected that the railway will be completed to both Spirit River and Grande Prairie early in 1916, and as there are roads

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leading from both of these places to Pouce Coupé, the prospective settler can choose his own route. From the latter place the pack-trail leading to Fort St. John has been improved sufficiently to allow the passage of wagons, as was also the pack-trail on the north side of Peace river from Fort St. John to a point within eight miles of Hudson Hope. At the latter point there are clay landslides extending to the water's edge, and to continue any farther, a road would have to be gouged out of these side-hills for a distance of nearly a mile, and when completed would not be permanent, as these clay slides are continually moving.

The condition of the services into this country has improved considerably during the past year. Fort St. John receives mail from Lake Saskatoon, Alberta, twice a month and this service was to be extended to Hudson Hope before winter set in. But as the delivery depends largely upon the state of the various rivers on the mail route, on none of which ferries are operated, the arrival during certain seasons, is still very irregular. The government telegraph line from Lake Saskatoon was extended to Hudson Hope last August.

Taking into consideration the general conditions found, and the probable developments of the next few years, this district has a promising future for both agriculture and industry.

APPENDIX No. 13.

ABSTRACT OF THE REPORT OF M. P. BRIDGLAND, D.L.S.

PHOTO-TOPOGRAPHICAL SURVEYS IN JASPER.

The party left Calgary on June 21, 1915, and arrived at Jasper on the following morning, but owing to cloudy and wet weather actual work on the survey near Jasper was not commenced until the 27th. From there it was carried south and west, covering the Athabaska valley to the mouth of Whirlpool river, and Miette valley to near Yellowhead pass. In order to include some tributaries entering the Athabaska and the Miette within the above limits, the work was extended south to cover townships 43, ranges 1, 2 and 3, west of the Sixth meridian. This portion of the work was completed on July 28.

Work was then continued down the east side of the Athabaska valley, covering the lower parts of the valleys of Maligne and Rocky rivers and Fiddle creek. The trails in these valleys are in good condition but the trail along the Athabaska is used very little and in high water is almost impassable. Good progress was made with the survey up to August 17, but during the remainder of the month, owing to rain or smoke, very little could be accomplished.

On August 31, the party crossed Athabaska river at Pocahontas, intending to work back along the west side of Jasper. The main streams entering from this side are Moose creek, Stony river, and Snaring river. There are trails up the two first-mentioned streams but none up the third. The main trail along this side of the Athabaska is in good condition except at one place where it is flooded by a beaver pond. Owing to continued unfavourable weather, this work required a longer time than had been expected and was not completed until September 27. A small party was then sent to the head of Jack creek near Interlaken, with instructions to extend the work there and in the valley of Rocky river, a little farther east, while the remainder of the party undertook to occupy two stations on the Maligne range overlooking the Athabaska valley to the south of Jasper. Owing to bad weather, these trips were only partially successful and both parties returned to Jasper early in October.

A traverse was made of the Grand Trunk Pacific railway from near Parkgate to Yellowhead pass to serve as a base for our triangulation system. During the summer when other work was impossible, this traverse had been carried from the eastern or northern limit to near Jasper. It was now continued to near Yellowhead pass and was completed on October 13. The party then returned to Jasper and made arrangements for storing the outfit and wintering the horses. On the 15th they left Jasper for Calgary where the men were paid off on October 18.

The season of 1915 was very unfavourable for photographic work. From June 24 to October 15, there were only forty-eight fine days out of a total of one hundred and fourteen, and even on the fine days there was nearly always a slight haze or heavy cloud shadows. In July, September, and October, much delay was caused by wet weather while in August twelve days were lost owing to smoke. These unfavourable conditions, combined with the unusual width of the valleys, made it very difficult to obtain satisfactory views.

The total length of the season was one hundred and twenty days. During this time, eighty-nine triangulation stations were occupied and a traverse of more than fifty miles of the railroad was made. About thirty of the more prominent peaks were located by triangulation, though not occupied.

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From a scenic standpoint, Jasper park has many attractions. The valley of Athabaska river is much wider than that of most mountain rivers. The valleys of Stony and Rocky rivers are also very wide with rolling benches extending back to the main ranges. The mountains seen from the railroad are comparatively low, most of them being from 7,500 to 8,500 feet above sea-level, or 4,000 to 5,000 feet above the valley. A few peaks reach an elevation of 9,000 feet or over. Near Jasper there are large flats and benches dotted by many beautiful lakes. Alpine districts of a more rugged nature may be reached easily from Jasper in two days. The Maligne lake district and that south of Jasper adjacent to the interprovincial boundary are especially worthy of mention.

The Miette hot springs are situated on the west branch of Fiddle creek about twelve miles from Pocahontas, from which place they are reached by means of a good pack-trail. The temperature of the different springs varies from 100 to 130 degrees Fahrenheit and the waters are said to have wonderful medicinal qualities.

Nearly all of the district included in our survey has been burned over and is now covered with a good growth of small jack pine, poplar, and spruce. Very little standing timber of commercial value was seen and the greater part of what does exist is in places difficult of access. In the mountains to the south and west of Jasper and on the south branches of Miette river, there is green timber but the valleys are narrow and rise quickly to a high elevation. The valley of Snaring river, as yet untouched by fire, is heavily timbered, but is very narrow. Good timber was seen also on the south branch of Stony river and on the upper part of Drystone creek. The timber is chiefly spruce twelve to eighteen inches in diameter.

So far as could be learned, no minerals of importance, other than coal, have been discovered. At Pocahontas there are coal mines on both sides of Athabaska river.

Game is protected throughout the park and is quite common. Sheep, goats, deer, caribou, and beavers were frequently seen. Only one bear was actually seen, although tracks were often noticed. In the main valleys there are many rabbits and coyotes, the latter being particularly in evidence. There are some game birds but they are not very plentiful, and in the fall a few ducks and geese visit the Athabaska valley and the neighbouring lakes. Fish does not appear to be plentiful in the streams, but it is reported that there is good fishing in some of the lakes near Jasper.

APPENDIX No. 14.

ABSTRACT OF THE REPORT OF J. H. BROWNLEE, D.L.S.

SURVEYS IN THE YUKON TERRITORY.

In company with H. G. Dickson, D.L.S., of Whitehorse, I made an examination of the Wheaton district and later of the Kluane district beyond Champagne Landing. Later I made an examination of the pasture land enclosed by the White Pass and Yukon route, on the west side of lake Laberge. I concluded that the best pasture lands were situated between Champagne Landing and Takhini, and it was decided to make these available by making stadia traverses of the meadows only, which is not expensive survey work.

I proceeded to Dawson and recommended a contract to Mr. Dickson including the unsurveyed portion of the Kluane road. This survey is complete, but the returns have not yet been received.

On July 13, I proceeded from Dawson to Mayo, surveyed Mayo Indian Reserve for the Department of Indian Affairs, made two small correction surveys at Minto for the Department of the Interior, and made an examination of Mr. Dickson's 1914 contract on Sixtymile river. The remainder of August and September were spent in preparing the returns of surveys made at Minto and Mayo.

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APPENDIX No. 15.

ABSTRACT OF THE REPORT OF J. A. BUCHANAN, D.L.S.

SUBDIVISION SURVEYS NORTH OF PEACE RIVER CROSSING.

The organization of my party was commenced at Edmonton on April 15, 1915. It was my intention to leave there for the scene of my season's work on April 25, but on account of freight car shortage we were delayed until May 5. We arrived at Peace River Crossing on the following day, having travelled the last thirty miles by trail.

On Monday, May 10, the outfit was loaded on a scow and we started down the river; on the following day we reached our first camp, in tp. 90-21-5.

Our work for the season consisted of the subdivision of townships 90, 91, and 92, range 21, and townships 91 and 92, range 20, all west of the Fifth meridian. As these townships are nearly all traversed by Peace river we used the river as our principal means of transportation. Our provisions were cached at convenient points along the river and most of our camps were located on the river bank.

Practically the whole of these five townships are thickly wooded with second-growth poplar and willow brush, and in many places the windfall is very thick. On account of the valleys of Peace river and the many small streams that flow into it, a great deal of the country is necessarily very rough, but there are several fine river-flats in these valleys. The table-land back from the river valleys will, for the most part, make good agricultural land. There are a few swamps, but in all cases these could be quite easily drained. The climate is fine and warm, and there are no frosts until well on in the fall.

I took the larger portion of the party out to Peace River Crossing during the first week in October, retaining only four men to assist in traverse work. This was completed in time to enable us to track up the river before it was finally frozen over. We arrived in Edmonton on October 31.

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APPENDIX No. 16.

ABSTRACT OF THE REPORT OF J. A. CALDER, D.L.S.

MISCELLANEOUS SURVEYS IN THE KAMLOOPS DISTRICT.

On April 14, 1915, I left Ashcroft with my party and proceeded to tp. 16-24-6, where our first work of the season was located. The subdivision of that part of the township outside of Nicola Forest reserve was completed, part of the reserve boundary was surveyed, and portions of Nicola river were traversed.

Subdivision was then carried into the northwest quarter of tp. 15-24-6, to include some valuable grazing and agricultural land. Nicomen Indian reserves Nos. 9 and 12, and Lower Nicola I.R. No. 11, were retraced and tied in. Some improvements claimed by Indians were found to be outside the reserves and on Dominion Lands.

On June 8, camp was moved to Potato Illahie, a small Indian village on Nicola river near the mouth of Skuhun creek in the same township. From this camp the boundaries of Nicola Forest reserve were established through the northeast quarter of the township and through tp. 15-23-6, where not already run, and the retracement of Lower Nicola I.R. No. 11 was completed, including the traverse of a portion of Nicola river. The land embraced by these surveys is mostly mountainous and broken. There are some extensive benches along the river in the Indian reserve, and some of these are well cultivated. Nicola river, where it passes through these townships, is very turbulent and averages from two to three chains in width. I am informed that it furnishes excellent fishing.

Surveys along the Nicola were completed on July 7, and on the following day we moved by train to Ashcroft, and thence by wagon to upper Hat creek, in tp. 19-26-6, where we arrived on the 10th. The road from Ashcroft to this district has been shortened recently. It now follows Oregon Jack creek and up over the divide to Hat creek, joining the old wagon road, via the mouth of Hat creek, in section 29.

The west half of this township was subdivided, where not already done, and the boundaries of Hat Creek Forest reserve were established. This district is well adapted for stock raising and dairying.

Our next work was in tp. 22-25-6, where portions of the boundaries of Hat Creek and Arrow Stone Forest reserves were surveyed and some agricultural and grazing lands subdivided. This district is essentially a stock country, and large quantities of hay and grain are grown along Bonaparte river for winter feed, while the surrounding hills furnish pasturage during the summer.

Our work in this vicinity was completed on September 15, and the main party moved to Barnes lake in tp. 20-24-6, while with one man, I proceeded to tp. 18-28-6, where an old provincial lot was reported to be on Dominion lands. This lot was retraced and tied to the Dominion Lands system, and I rejoined the party on the 21st.

In township 20, range 24, some subdivision was made, a portion of the western boundary of Nicola Forest reserve was run, and a lake which was discovered last season on previously surveyed lands, was traversed. The portion of the township embraced by our work is hilly and open or sparsely timbered with fir and bull pine. Mixed farming is carried on in a small way, but the country is best adapted for stock raising. In connection with the resources of this district I might mention that we made the acquaintance of a man who was engaged in locating colonies of wild bees. While we were working in that vicinity he found six or eight "bee trees," yielding profitable quantities of honey.

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Our work in this township was completed on September 22, and our next move was to tp. 22-21-6. The party and supplies were ferried by gasoline launch from Savona across Kamloops lake, to the mouth of Copper creek. From this point there is a fair wagon road up Copper creek to Seven Lakes post office, about the middle of the township. The southerly boundary of Tranquille Forest reserve was completed through this township and some resurvey work was done. A number of quarter-sections along Copper creek and on the divide towards Sparks lake have been settled on in recent years, and small patches brought under cultivation.

My party was discharged at Ashcroft on October 6, after which I was engaged for a few days on a small survey in tps. 20 and 21-26-6. I arrived home on October 14.

APPENDIX No. 17.

ABSTRACT OF THE REPORT OF WM. CHRISTIE, D.L.S.

SUBDIVISION SURVEYS AND BASE LINE RETRACEMENT NORTH OF PRINCE ALBERT.

My summer work consisted of the subdivision of a part of township 52, range 21, part of township 53, range 20, all of townships 53, ranges 21, 22 and 24, and the south two-thirds of townships 54, ranges 22, 23 and 24, all west of the Second meridian.

I left Prince Albert with my party on May 14 and arrived in tp. 53-24-2 on the 17th. Work was commenced the following day, and from that date was continued with but a little interruption until October 9, when our subdivision surveys were completed.

Three main wagon roads from Prince Albert cross the portion of country covered by this survey. The most westerly of these passes through settled country by way of Henribourg, in tp. 51-25-2, and thence to Paddockwood in the next township north. From Paddockwood a road, locally known as the Mosher trail, runs northerly across tp. 53-25-2, and thence northeasterly to Torch lake. The road is graded and in good condition from Prince Albert to the north boundary of tp. 51-25-2. From there north it is fairly good during dry weather, but rather bad during wet weather.

The second road runs northeasterly from Prince Albert to Candle lake. There are places in this trail over which it would be impossible to haul loaded wagons in its present condition. I opened a wagon trail from sec. 30 to sec. 9, in tp. 54-23-2, connecting the Candle lake trail with the Mosher trail.

The most easterly of the three roads referred to is graded through settled country to Meath Park in tp. 51-23-2. From there it follows the Hudson Bay and Pacific railway line which runs in a northeasterly direction across tp. 52-21-2 and tp. 53-20-2. During dry weather this trail is fairly good as far as the centre of tp. 52-21-2, but during wet weather, it would probably be bad in spots. Farther north it is very bad in some places.

The land between Prince Albert and Paddockwood is mostly taken up. Many farms in the Henribourg district present quite a prosperous appearance, but farther north, in the Paddockwood district, settlement has been more recent. Wheat, barley, oats, potatoes, and garden vegetables are grown successfully on a small scale. The country between Henribourg and Meath Park is all settled and presents a prosperous appearance.

No squatters were found on any of the land surveyed during the season, but a number of settlers have located in tp. 53-24-2 since the completion of the survey.

Most of the land in these townships is gently rolling and covered with poplar, spruce, jack pine and tamarack, but most of the timber which is of merchantable quality is included in the various timber berths in the district. Some areas of timber have been fire-killed during recent years. The soil is clay, clay loam, or sandy loam, with varying depths of muck and leaf mould on the surface.

There are a number of small lakes in the district, but the only one of importance is Birchbark lake in townships 52 and 53, ranges 21 and 22. It is about six miles long and averages about two miles in width. Its most important outlet is Birchbark creek which flows northerly into Torch lake. No streams flow into it.

Very little hay is to be obtained in any of the townships surveyed. In most places where the country has been burned over, however, good grazing is found.

All the muskegs are shallow and there is ample slope to render draining comparatively easy. If these muskegs were drained and the moss burned off, I have no doubt

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that they would furnish excellent hay lands, even if they are not suitable for other crops.

The climate throughout the district resembles that at Prince Albert. Summer frosts occur, but are not often severe enough to seriously damage crops.

All the water in the district is fresh, and the supply is sufficient and permanent.

Big game is plentiful throughout the district. It consists of moose, elk, caribou, and bears. Coyotes are also very numerous. Foxes, beavers, muskrats, partridges, prairie-chickens, and ducks were also noted. Jackfish are found in Birchbark lake, but do not appear to be very plentiful.

No coal, lignite, stone-quarries, nor minerals of economic value were noted.

Early in March of 1916 I organized another small party for the retracement of the 15th base line through ranges 22 to 27, inclusive, west of the Second meridian.

We left Prince Albert on March 13, and travelled by sleigh to our destination. The road from Prince Albert to the south end of Torch lake was in good condition. From this point to the base line we travelled over Torch and Candle lakes, breaking our own trail as we went. On arriving at the intersection of the base line with the east shore of Candle lake I sent two teams back to Henribourg to bring up sufficient hay and oats to last throughout the work.

Work on the line was commenced at the NE. cor. tp. 56-22-5, on March 20. The snow was very deep in the vicinity of the line, making progress difficult and slow. The retracement was completed to the Third meridian on April 6, and on the following day we started via the Montreal Lake trail for Prince Albert where we arrived on the 11th.

The country crossed by this line is very similar to the townships to the south which I subdivided during the previous summer, except that in the eastern portion there is more muskeg.

The line crosses Candle lake in range 23, about a mile from the north end of the lake. This lake is about fifteen miles long from northwest to southeast and from two to five miles wide. Whitefish and jackfish were caught quite extensively in this lake a few years ago, but the industry has been practically abandoned.

Bittern lake is crossed by the line in range 26. It is about seven miles long from north to south and from one to two miles wide. The greater part lies north of the base line. Whitefish are said to be plentiful in this lake.

From Bittern lake to the Third meridian the land is rolling and timbered with poplar, birch, spruce, and jack pine up to about six inches in diameter, with local areas of spruce and tamarack muskeg.

The snowfall during the past winter in the vicinity of the 15th base line was heavier than usual, and the spring somewhat later, but the climate generally does not differ materially from that at Prince Albert.

Moose, elk, caribou, and coyotes are plentiful in the vicinity of the line, and foxes and timber wolves were also seen.

APPENDIX No. 18.

ABSTRACT OF THE REPORT OF G. W. COLTHAM, D. L. S.

STADIA SURVEYS IN THE WAINWRIGHT DISTRICT.

Survey operations were commenced in tp. 45-8-4 on June 2, and traverses of lakes and investigations of other water areas were completed in the following townships throughout the season:—

Township 44, range 9, township 45, range 8, townships 44 and 45, range 7, townships 43, 44 and 45, range 6, townships 43, 44 and 45, range 5 and township 44, range 3, all west of the Fourth meridian.

In several of these townships the necessary monuments were established where bodies of water had dried up since the original survey of the township, but where this work could not be carried on conveniently and expeditiously, it was left undone.

The water in most of the lakes traversed during the season was alkaline but not to such an extent as to render it unfit for stock, and after boiling or filtering through the soil, was quite fit for drinking. Baxter lake in townships 45 and 46, ranges 5 and 6, contains turbid water which is practically soft and is of a most unpleasant taste.

The farmers throughout the entire district visited appear to be singularly prosperous. This district has many natural advantages,—the soil permits of easy cultivation, the surface is gently rolling or undulating with consequent adequate drainage, good water for domestic purposes is nearly everywhere obtainable at moderate depths, while the rainfall is sufficient to ensure proper growth of all field crops. I was informed that destructive early frosts were unusual.

No minerals or mineral-bearing rocks of economic importance were seen.

Game is not particularly plentiful. Ducks were seen on nearly all the lakes, and on Baxter lake several geese were noticed. Prairie-chickens are fairly numerous.

The weather during the month of June and July was fine with occasional showers. The farmers regarded the season a very favourable one as to weather conditions.

APPENDIX No. 19.

ABSTRACT OF THE REPORT OF J. M. COTE, D.I.S.

MISCELLANEOUS SURVEYS IN SASKATCHEWAN.

My first work for the season was the completion of the resurvey of tp. 51-23-3 which I had left unfinished in 1914. This township is dotted with poplar bluffs, willow bush and numerous small lakes and sloughs. The water in most of the sloughs is fresh, which, coupled with the abundant hay growing around the lakes and sloughs, makes the district ideal for ranching. The settlers are mostly French Canadians who seem to be quite prosperous. This resurvey was completed on May 8 and on the 10th I left for tp. 47-22-3, crossing Saskatchewan river by the Paradise Hill ferry, which is in the west of range 24. The country along the trail followed is hilly, with patches of poplar and willow bush, and is thinly settled.

The surface of tp. 47-22-3 is gently undulating to rolling, dotted with poplar bluffs and willow bush, and the soil is mostly sandy loam. The main line of the Canadian Northern railway crosses the township.

On June 1 we left for tp. 40-14-3, following the old Edmonton-Battleford trail to Battleford and thence over local trails and road allowances. Although the country passed through has been opened for a number of years it is thinly settled. It is rolling and covered with poplar and willow bush, with some open patches.

We resurveyed those parts of tp. 40-14-3 lying outside of Keppel Forest reserve and on June 25 proceeded by trail to Bad lake in tps. 27 and 28-18-3, and from there to Kiyiu lake in tps. 30 and 31-21-3. The land along these trails is all occupied and the settlers, the majority of whom depend solely on grain growing, find it sometimes hard to make a living. Both Kiyiu and Bad lakes previously reported dry, were on account of the wet weather, full of water. It was therefore impossible to carry out the instructions received to extend the subdivision lines across the dried-up portions of the beds of these lakes.

On July 7 we left for tp. 27-27-3, which we resurveyed. The work there was somewhat delayed owing to the huge stone piles found at all the corners, and which had to be removed. This country has only been opened up for five or six years, but is nevertheless well settled. While the main party carried on operations in this township, I drove to tp. 27-28-3, to correct certain markings on the witness post at the northeast corner of section 22.

On July 23 we started for the vicinity of Duck Lake, Saskatchewan. From Flaxcombe to Fiske, a distance of fifty-two miles, we followed a good graded road along the south chord of township 29 and then followed the roads between towns along the Canadian Northern railway. The district passed through is well settled and the crop outlook was good.

We arrived in tp. 43-2-3 on August 3, and began the resurvey of this township and the one immediately north of it. They are thickly settled, some homesteaders having lived there since the early eighties. The surface is nearly level and is mostly well covered with poplar from four to ten inches in diameter and willow bush. Many lakes and sloughs occur. All the surface water is more or less alkaline but farmers get an ample supply of good water from wells twenty to forty feet deep. The Saskatoon-Prince Albert branch of the Canadian Northern railway passes through these townships. Most of the old surveyed trails are being abandoned as the road allowances are gradually being opened up. Although wet weather prevailed generally throughout

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the western provinces during 1915, it was very dry in this district and the crops in consequence were not very good.

The resurvey of certain lines in tp. 43-27-2 was the next work undertaken. While the main party was employed on this work a sub-party retraced a few lines in tp. 43-28-2. I also visited tp. 41-23-2. It has a rolling surface covered with patches of poplar and willow bush. The soil is good and I was informed that crop failures were unknown in this district. Middle lake lies in the northeast corner of the township; it is three or four miles across.

I closed operations on October 25, and proceeded to Humboldt where the party was discharged.

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APPENDIX No. 20.

ABSTRACT OF THE REPORT OF G. C. COWPER, D.L.S.

STADIA SURVEYS IN SOUTHWESTERN SASKATCHEWAN.

My work for the season of 1915 was confined to a group of about eighty townships in the vicinity of Swift Current, and consisted of the traverse by stadia of all lakes of a permanent character over five acres in extent and of rivers averaging a chain or more in width, the investigation of all lakes and sloughs which had dried up since the original survey, or which were likely to dry up, and the erecting of monuments in the dried-up beds of lakes.

The work was commenced in tp. 6-21-3, where we traversed Frenchman river and surveyed two irrigation reservoirs. From there we worked easterly and then northerly through townships 8, 9 and 10, range 19, and township 10, range 18. No lakes were found in the latter township.

In sec. 31, tp. 6-21-3 is situated the thriving town of Eastend. An excellent clay for pottery is found near there and also an excellent quality of quartz sand suitable for making glass. A fair quality of lignite coal in small veins is to be found in the Cypress hills to the west. Surface indications of oil and gas were noticed, and well-drilling operations were in progress. If gas is found in commercial quantities, Eastend may become an important manufacturing town. In the valley of Frenchman river in this township is located the largest privately-owned irrigation system in southern Saskatchewan.

On completion of this work we moved to tp. 13-17-3, and throughout the remainder of the season we progressed as follows, investigating as we went: First northerly through townships 13 to 16, ranges 16, 17, and 18, thence easterly through townships 15 and 16, as far as range 8, then back westerly through townships 17, 18, and 19, as far as range 16, and finally through the townships along South Saskatchewan river between ranges 14 and 18, inclusive. Altogether we completed the investigation of sixty-seven townships and partly investigated seventeen others. The work was finished on October 22.

Antelope lake in tp. 15-18-3, was the largest lake traversed during the season. It is about four miles long, a mile and a half wide, and about thirty feet deep in the centre. It is fed by Thirty-two-mile creek and by springs, but as it has no outlet the water is alkaline.

Another permanent lake was found in townships 17 and 18, range 15. This lake is about two miles long, from ten to thirty chains wide, and thirty feet deep. It is fed by springs, and is strongly alkaline.

In townships 17, 18, and 19, ranges 8, 9, and 10, where there were a large number of lakes at the time of the original survey, I found very few water areas still in existence. Rush lake, in townships 17, ranges 10 and 11, which was formerly about five miles long and from two to three miles wide, is now dry, and the main line of the Canadian Pacific railway crosses the centre of the old bed. The railway company was largely responsible for draining it.

Most of the lakes throughout the district were found to have dried up, and many of the dry beds are producing good crops of hay. In the event of a series of wet seasons a number of them may fill up again but it is unlikely that they will ever hold water for any length of time. With two or three exceptions, all of the lakes traversed were from one to two feet in depth, with soft alkaline bottoms.

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The traverse of Saskatchewan river through ranges 14 to 18, inclusive, was commenced on September 11. The course of the river was found to have changed considerably since the original survey. A large number of islands, not shown on the original township plans, were also surveyed. They were found to be most numerous in ranges 17 and 18. These islands as well as the banks of the river are mostly covered with dense willow and small poplar.

The valley of the river, except in tp. 20-16-3, where it is two miles wide and about 400 feet deep, has gently sloping sides, and the river has low banks. The valley is well settled. There are still a number of ranchers along the river, but practically every quarter-section which is not under lease for grazing purposes has been homesteaded.

The Provincial Government has three ferries in operation in the townships in which I worked, to enable the settlers north of the river to reach the railroad to the south. One of these ferries is located in tp. 20-17-3, one in tp. 20-16-3 and one at Saskatchewan Landing in tp. 19-15-3. The last is a very old crossing, as it is at the point where the trail from Swift Current to Battleford crosses the river. It was along this trail that the troops moved in going from Swift Current to Battleford during the Northwest Rebellion.

This district is in the dry belt, and the rainfall usually is light. In 1915, however, it was abundant, and the land on which the crops of 1914 were almost a total failure, yielded as high as sixty bushels of wheat, one hundred bushels of oats, or thirty bushels of flax, per acre.

Some of the settlers, especially those in the townships along South Saskatchewan river, have great difficulty in getting water. In some cases the river is the only source of supply. In other parts of the district the Provincial Government has constructed reservoirs by damming small coulees and excavating basins in front of the dams. Some of the reservoirs noticed were about 500 feet long, by 200 feet wide, and twenty feet deep.

The district is well settled and well served by railroads. The main line of the Canadian Pacific railway runs westerly through the centre; the Weyburn-Lethbridge branch parallels it to the south, while the northerly portion is served by the Swift Current-Bassano branch.

In many of the townships examined practically every quarter-section was under crop, and the majority of the road allowances are graded. A large number of the settlers have telephones, and are on rural free mail-delivery routes, and every year these services are being extended. It will not be many years until southern Saskatchewan, which ten years ago had very few settlers except the ranchers, will have all the conveniences enjoyed in the rural districts of Ontario.

APPENDIX No. 21.

ABSTRACT OF THE REPORT OF A. L. CUMMING, D.L.S.

SUBDIVISION SURVEYS WEST OF ROCKY MOUNTAIN HOUSE.

My work for the season of 1915 consisted of original subdivision in townships 41, range 9 and 10, the northerly one-third of township 39, range 10, and those parts of townships 39 and 40, range 11, lying north of Saskatchewan river, all west of the Fifth meridian.

To reach this district, we travelled by train from Edmonton to Rocky Mountain House, and thence by wagon to tp. 41-10-5. The work lasted from May until November.

Townships 41, ranges 9 and 10 are best suited for ranching purposes. They are rolling and well wooded, and have a luxuriant growth of grass and peavine.

The other lands covered by my survey are mostly wooded with second-growth spruce, jack pine, and poplar, most of the valuable timber having been cut off for the timber work in connection with the Canadian Northern railway, which passes through these townships. The soil throughout is good but the surface, on the whole, is too hilly to be suitable for farming. A number of oil claims have been located in these townships but very little development work has been done.

Large game abounds in this district, moose, deer, and beavers being very plentiful. Coyotes are also numerous, but not many foxes, mink or martens were seen.

APPENDIX No. 22.

ABSTRACT OF THE REPORT OF T. A. DAVIES, D.L.S.

SUBDIVISION SURVEYS NORTHWEST OF DUNVEGAN.

My work for the season of 1915 consisted of the subdivision of townships 80, 81, 83, 84, and the westerly half of township 82, range 5, and the easterly one-third of township 80, range 6, all west of the Sixth meridian.

The party, which was organized at Edmonton, left on May 11, via the Edmonton Dunvegan and British Columbia railway. From the end of steel to Peace River Crossing the road was found to be very bad, making freight rates excessive, and the part from Peace River Crossing to Dunvegan, which is usually in good condition, was soft and muddy. Two days were spent in cutting a trail into tp. 81-5-6, the scene of our first work, where we arrived on May 22.

During the first six weeks our work was considerably hindered by the excessive rains, but during the latter part of the season the weather was fine.

The district covered by my surveys seems best suited for mixed farming. The soil is a black loam with a clay subsoil. The surface generally is undulating and timbered with poplar and spruce. There are some creeks but they are neither large nor numerous. No lakes, ponds, or sloughs of appreciable size were seen. At present grain growing is carried on successfully in the district immediately to the east of these townships.

Township 81, range 5, and the part of township 80, range 5, north of Peace river are cut off from the east by a creek which flows southerly along the east boundary of these townships. At present there is no road across it except an indefinite pack-trail, and it would be very expensive to build a wagon road on account of the depth and roughness of the valley.

Our work was brought to a close on October 15.

APPENDIX No. 23.

ABSTRACT OF THE REPORT OF H. S. DAY, D.L.S.

SUBDIVISION SURVEYS NORTHWEST OF DUNVEGAN.

After organizing my party and completing my outfit, I left Edmonton on May 4, and proceeded by rail to Reno, and thence by wagon via Peace River Crossing to Vanrena, a post office about twelve miles north of Dunvegan. For the first part of the journey, from Reno to Peace River Crossing, the road was bad, but from there to Vanrena, it was in excellent condition and good progress was made.

At Vanrena we stored part of the provisions for use during the latter part of the season, and proceed with the remainder to Island lake where they were cached with a rancher. From there we continued along the Fort St. John pack trail to the 22nd base line which we then followed as far as tp. 84-6-6, where our work commenced.

During the season we surveyed tps. 81, 82, 83, and 84-6-6.

These townships are traversed from north to south by the valley of Peace river, which in this district, is from 800 to 900 feet deep, with very steep sides, the river itself being a little over a quarter of a mile in width. During the flood season in July and August it was at least fifteen feet deeper than during normal periods.

There is little merchantable timber in the district-except on the west side of the river in township 81, where there is some good spruce. It would be difficult to get this out, however, on account of the many deep ravines in the township.

While there are considerable areas in these townships which are suitable for agriculture, they are somewhat isolated on account of the valley of the creek in range 5, which cuts off communication with the settlement to the north of Dunvegan. The district would therefore seem best suited for grazing purposes. There are, however, no large hay meadows and a rancher would find it necessary to grow fodder of some kind.

Most of the quarter-sections along the road from Peace River Crossing to Dunvegan have been taken up, and the settlers who have land under cultivation report excellent crops. The main crop consists of wheat and oats. I saw a forty-acre field of oats which averaged over one hundred bushels per acre, and wheat averaged from thirty to fifty-five bushels per acre. All ordinary vegetables seem to do well in this district. Well-ripened tomatoes were seen and several gardens were noticed where sweet peas and pansies were growing in profusion. So far the settlers in this district have had no crop failures on account of summer frosts.

Only a limited number of horses and cattle have so far been taken to this district, owing to the difficulties of transportation. This will no doubt be quickly remedied now that the railway is so easy of access. Horses from outside districts do not seem to do well, and large numbers have died from what is known as swamp fever. It is probable, however, that some way of combatting this disease will soon be found.

The main portion of my party and outfit returned to Edmonton on October 4. The remaining members, who were left to traverse Peace river through the townships surveyed, reached Edmonton on the 16th.

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APPENDIX No. 24.

ABSTRACT OF THE REPORT OF W. J. DEANS, D.L.S.

MISCELLANEOUS SURVEYS AND INSPECTION IN MANITOBA AND SASKATCHEWAN.

On July 28, 1915, I left Prince Albert for my first work, the inspection of the surveys done by Mr. W. Christie, D.L.S., south of Candle lake.

The country north of Prince Albert for a distance of about eight miles is largely sand hills, but there are some small areas of good land which are settled on. About four miles south of Henribourg the country changes from sand to a deep black loam well adapted for farming purposes, and it is well settled up to a point three miles north of Paddockwood; from there to Candle lake the country is largely jack pine ridges with marshes and muskegs, and not of much value for farming purposes.

Township 53-24-2 contains some good land, but at the time of my visit was without any settlers. The township is rolling and covered with a thick growth of quite large poplar and spruce, but in many places there are good open spots which would require very little work to clear. The soil is a good black loam with clay and sand subsoil.

On our return trip to Prince Albert we visited tp. 51-26-2 and traversed a lake which had been overlooked in the original survey of the township.

On August 9, we left Prince Albert and proceeded to Winnipegosis, where a boat was hired to take the outfit to tp. 37-17-Pr., a distance of about fifty miles. The work there was to inspect the survey of Mr. O. Rolfson, D.L.S. While in that vicinity I also visited tp. 34-17-Pr. in order to place a post which had been omitted in the original subdivision. Townships 37 and 38, range 17, of Mr. Rolfson's survey, lie along the east side of lake Winnipegosis, are low and level, and are covered with a thick growth of poplar, willow, and spruce. In many places there are extensive tamarack swamps, but there are a few good locations along the shores of the lake which are suitable for settlement.

Our next move was to tp. 14-15-E. to inspect the work of Mr. W. A. Scott, D.L.S., who was engaged in subdividing townships in eastern Manitoba south of Winnipeg river. In order to reach this township we travelled by train to Lac du Bonnet, thence by the City of Winnipeg's tramway to Point du Bois, from there by canoe down Winnipeg river some three miles, and then over a portage of a mile and a quarter to lake George.

The land in townships 14 and 15, range 15, is largely rock ridges and swamps. There are, however, numerous small areas of fine rich land which would yield an abundance of potatoes and vegetables. There are also many patches of land which would be fit for agricultural purposes by drainage.

A few settlers around lake George are engaged in fishing and trapping. This lake is quite a resort for tourists in summer and is patronized by Winnipeg people attracted by the many beautiful camping places around the lake and the abundance of fish in its waters. It is somewhat difficult to reach, which adds additional charm and lures the more adventurous.

On July 28, we started for tp. 24-6-E., on Hecla island in lake Winnipeg, passing through Lac du Bonnet, Winnipeg, and Selkirk. We were detained at Selkirk two days waiting for the steamer which sails weekly for all points on the lake. On September 2, work was started on the resurvey of this township. The monuments were either destroyed or had fallen down so that the settlers were in doubt as to their boundaries and had petitioned to have a resurvey. I spent about six weeks in this

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township retracing all the lines and re-marking the corners, in many cases with the new style of iron posts. The township fronts the lake on the east side, and is well settled along the shore with Icelanders and their descendants, who are largely engaged in fishing and cattle raising. There is little or no attempt made at farming. The settlers do not even appear to raise sufficient potatoes and vegetables to supply the local demand. The interior of the township is largely tamarack swamp and hay meadows and could be easily drained and made useful as the soil beneath the moss of the swamps is good. The westerly side is low and consists of hay meadows with ridges of poplar. A great deal of hay is cut in this part, baled up, and shipped to Winnipeg. In the fall and winter the settlers are all engaged in fishing and large quantities of fish are caught and hauled to Riverton, the nearest railway station. From Riverton they are distributed throughout eastern Canada and the United States. Last season the fishermen were not as successful as usual. The lake was frozen to a depth of about four inches in November, but from that time on heavy falls of snow prevented it from freezing to the usual thickness; thus travel was attended with great danger, many teams going through, and loads of fish were endangered.

Hecla, the post office immediately north of this township, is the point where nearly all of the prospectors and miners pass through on their way to the Rice lake gold mining country. During the season of navigation the best way into this new mining camp is from Selkirk to Hecla by steamer. The Northern Fish company's steamer Wolverine leaves Selkirk every Wednesday and reaches Hecla the same day. From Hecla a sailing boat or gasoline launch may be taken to Bad Throat, and from there a canoe route extends up Manigotagan river to the mining camp. At Bad Throat there is a settlement of Indians who are always ready to furnish canoes and to act as guides. There is a good store at Hecla and also one at Bad Throat where provisions may be obtained at a very reasonable rate, but in going into this camp it would be advisable to buy an outfit at Selkirk or Winnipeg.

I have seen some fine samples of gold-bearing ores from this camp. Up to the present time very little development work has been done, but that little has been so encouraging that one company is spending a large amount this year, and I have no doubt that Manitoba will soon have one or more mines producing gold in paying quantities. The best way into this mining camp in winter is to Riverton on the Canadian Pacific railway and thence by team to Bad Throat.

On October 15, we left Hecla for Bedford, a station southeast of Winnipeg on the main line of the Canadian Northern railway. A number of settlers had squatted on land in that vicinity and made improvements, so that before the land could be subdivided into lots certain preliminary surveys had to be made. The settlers on this land are mostly engaged in the cordwood business, the surrounding country being thickly covered with jack pine, tamarack and spruce and a ready market is found for this wood in Winnipeg.

Our next work was at Sandy Lake, a station on the Canadian Northern railway in the Riding mountains. On account of the beauty of this lake and the surrounding country many summer visitors are attracted, and as some of them had erected cottages on the shores of the lake and wished to obtain patent to the land it was necessary to lay it out into lots.

On November 2, we started for Swan lake, in townships 21, ranges 5 and 6, west of the Principal meridian. On account of unusually dry summers, and the waters to the north being diverted in other directions, this lake which was quite large when the original survey was made had almost dried up. Our work was to extend the lines of subdivision so as to take in the formerly submerged lands.

The settlers in these townships are chiefly engaged in mixed farming. Last year quite a large area was sown in wheat and oats. The cutworm did great damage to the

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oats, but the crops were fairly good. The settlers in this part are of many nationalities and appear to be industrious and prosperous.

While on this work the weather was very unsettled, storms and blizzards occurring nearly every day, and as our work was in the open to a great extent, our progress was somewhat slow.

On November 10, I took one man and started for Wymark, while my assistant with the remainder of the party went to Lily Bay to run some lines in tp. 20-7-Pr. This township is along the easterly side of lake Manitoba and owing to the dry seasons the marshy lands had dried up and were yielding large quantities of hay. The lines were obliterated so that there was great uncertainty as to which quarter-sections the hay was on. It was therefore desirable that the lines should be retraced and the corners marked with durable monuments. We also traversed the lake along this township.

My work at Wymark was to place some posts in the easterly limit of the Canadian Pacific Railway yard and move other posts to new positions. I accomplished this work and rejoined the party at Deer Horn on November 26.

We then proceeded to tp. 34-7--Pr. to inspect the work of Mr. J. W. Tyrrell, D.L. S., who was making subdivision surveys along Dauphin river. The country on both sides of this river is level and covered with a thick growth of poplar, spruce and willow. There are many hay meadows and swamps, alternating with poplar-covered ridges of good land which furnish good locations for the settlers. The advantage of settling in this district would be its accessibility by water from Fairford during the season of navigation; in winter good trails lead to Gypsumville. There is plenty of timber for building purposes and fuel, and an abundant supply of hay and water; large game is plentiful in the forest, and the river has a good supply of fish of the best quality. In winter the settler can find employment fishing, and there is a good market with fair prices. On December 17, we returned to Deer Horn with the intention of going east to lake Winnipeg where some work was required, but the trip had to be abandoned as the ice on the lake was not thick enough to carry teams. I therefore proceeded to Brandon where the party was paid off.

On February 10, I again engaged a few men and proceeded to Riverton to re-inspect contract No. 27 of 1913. The snow was so deep that I found that it would be almost impossible to take horses out to this work, so I had to engage two dog teams. I spent a week on this work. In many places the snow was six feet deep, even in sheltered places in the bush, and it was impossible to get along without snow-shoes.

While at Riverton I met a large number of miners and prospectors going to the Rice lake mining country; they were all very enthusiastic about the new mining camp.

The fish business on lake Winnipeg has developed to large proportions. While at Riverton, I saw two hundred tons of fish shipped to points in the United States and eastern Canada. Companies operating in this district supply outfits on credit to settlers wishing to engage in the fishing business, each settler agreeing to sell his whole catch to the company from whom he receives the outfit. When the season is over a settlement is made and generally the settlers have good balances to their credit.

The season was not a very good one for field operations. In September and October we had an excessive rainfall which greatly retarded the work. November was very stormy and blizzards were a daily occurrence in the part of the country in which I was operating.

The snowfall this season has been very great so that field operations in February were carried out under exceptional difficulties.

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APPENDIX No. 25.

ABSTRACT OF THE THE REPORT OF S. L. EVANS, D.L.S.

MISCELLANEOUS SURVEYS IN SOUTHERN SASKATCHEWAN.

Our first work was the resurvey of tp. 13-27-2 which was commenced on May 7 and finished on the 25th.

This township lies about twenty-five miles south of the city of Moosejaw and is crossed by the Moosejaw-Expanse branch of the Canadian Pacific railway. The surface is open, hilly prairie and is generally stony. Most of the land has been taken up in recent years, and mixed farming on a small scale is being carried on. There are some large ranches in the township which have proved a successful venture and it would appear that owing to the roughness of the surface, the district is better suited for cattle raising than for grain growing. There is plenty of slough hay throughout the township, and well water is easily obtained.

Our next work was the extension of the subdivision lines across the dried-up portions of the bed of Chaplin lake in townships 15, 16, and 17, ranges 4, 5, and 6, west of the Third meridian. This necessitated a two days' drive across the district north of lake Johnston and by way of Corval. Most of the country travelled through has only recently been taken up, and to the north of lake Johnston considerable areas are under lease for grazing purposes. The soil is generally a sandy loam, and some of the settlers are making fair progress at grain growing.

Chaplin lake, which was shown in the original survey as being about twenty-five miles in length, has in recent years dried up considerably, and at the present time covers only about one-half of its original area. This lake is strongly alkaline and has an average depth of only a few feet. It is gradually drying up from the south, and the portion originally extending into townships 15, ranges 4 and 5, and township 16, range 5, is now nearly dry. The dry bed is covered with a sparse growth of grass, and in a few years it should make good pasture; at the present time it is practically worthless. Some difficulty was experienced in surveying this dried-up lake area owing to the soft ground. The portion of the east half of township 15, range 4, not covered by the lake bed was retraced while we were in that township.

Township 16, range 5 and township 17, range 6, were next retraced and the subdivision was extended over the dried-up bed of Chaplin lake. These townships have a rolling prairie surface and the soil is a sandy loam. They are fairly well settled, and the settlers are making fair progress at grain growing. A few years ago it was generally thought that there was an insufficient rainfall in this district for successful grain growing, and consequently the lands were left open, but they have recently been taken up. During the last few years there has been plenty of rainfall and excellent yields of wheat and oats have been obtained.

The south two-thirds of township 17, range 5, was next traced. The main line of the Canadian Pacific railway passes through this township, and Chaplin station is located in section 29. South of Chaplin the Government have recently built, at considerable expense, two long trestle-bridges across Chaplin lake connecting the island and the mainland. People to the south of the lake are thus afforded a shorter road to market than formerly.

While engaged on the resurvey work around Chaplin lake some retracement work was done at Mortlach, in tp. 17-1-3, for the purpose of obtaining information to assist in establishing the longitude of the Third meridian at this point. This work was completed on August 2.

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Our next work was the complete retracement of townships 26, ranges 8, 9, and 10, west of the Third meridian. We travelled across country, going by way of Ernfold and Morse, crossing South Saskatchewan river at Log Valley ferry and thence going northwards through the district around Lucky lake. Considerable difficulty was experienced in crossing the river at Log Valley as there is a very soft sandbar in the middle of the river, and the loads had to be transferred from one ferry to another. We were over half a day in getting the outfit across the river. The country north from Morse to the river is a very fine grain-growing district. The land is well settled, and this year splendid crops have been threshed, there being plenty of rainfall.

North of the river through the district around Lucky lake the rainfall was not so heavy. The district is level prairie and the soil is a heavy clay. The lands have been taken up only during the last few years, but fair progress at grain growing has been made by the settlers. At the present time they have long hauls to market, there being no railroad in the vicinity. The Grand Trunk Pacific branch line running west from Moosejaw is in operation as far as Saskatchewan river; west of that the line has been surveyed but has not yet been constructed. When this is in operation this section of the country should become a very large grain producing district.

Townships 26, ranges 8, 9, and 10, are largely in the Coteau hills, and the surface is rolling or hilly prairie. These townships are fairly well settled. In ranges 8 and 9 there are large settlements of Finlanders; these people are industrious and will make first-rate citizens. Grain growing is carried on successfully in the district and some of the rough lands are suitable for cattle raising. From information received from the settlers there has always been an abundance of rainfall since the district has been settled, and this year a bumper crop was threshed, oats yielding one hundred bushels, and wheat as high as forty-five bushels to the acre. The work in these townships was completed on October 8.

We next moved across country to tp. 32-5-3, crossing South Saskatchewan river at Outlook. The country in the Outlook district has been settled for several years and the good class of farm buildings indicate that the settlers have been very successful. Extra large yields of grain were threshed there last year.

The part of township 32, range 5, outside the Dundurn Forest reserve was resurveyed. The land resurveyed is largely sand hills covered with small poplar and scrub. In the south end of the township there are extensive areas of wild hay, and large quantities of pressed hay are put up and shipped to outside points. The settlers in the township are engaged in cattle raising, and this should prove very profitable, as the conditions are ideal, there being plenty of feed, fresh water, and shelter for the cattle.

The east boundaries of sections 25 and 36, township 31, range 6, were also resurveyed. This work was completed on October 29, after which the party was disbanded.

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APPENDIX No. 26.

ABSTRACT OF THE REPORT OF S. D. FAWCETT, D.L.S.

SUBDIVISION SURVEYS IN POUCE COUPÉ PRAIRIE, PEACE RIVER BLOCK.

I left Edmonton with my party on May 11, 1915, and proceeded by the Edmonton Dunvegan and British Columbia railway as far as Reno, which was the end of passenger traffic at that time. From there to Peace River Crossing, a distance of about thirty miles, we travelled by wagon, hiring teams for transport. As is usual at that time of year, we found the roads in a very muddy condition.

On May 17, we left Peace River Crossing on board the Hudson's Bay company's steamboat "Peace River", and on the 19th arrived at the mouth of Kiskatinaw river, where by previous arrangement, our pack-train met us.

From this landing a road leads into Pouce Coupé prairie. The first two miles of it, leading up out of Peace river valley is rough, but the remainder is a good wagon road. We hired sufficient teams to haul all our supplies to the neighborhood of our work in one trip.

Our work consisted of the subdivision of townships 77 and 80, range 16 and townships 77, 78, and the eastern two-thirds of township 80, range 17, all west of the Sixth meridian. This was completed early in October and on October 10, I left with twelve men for Fort St. John, travelling over the Government telegraph road which was cut out when the wires were strung from Pouce Coupé to Fort St. John. This is a good road and there are no heavy grades except where the various streams are crossed. The descent to Pine river is the most difficult of these grades, the valley being about 800 feet deep. Pack-horses find no trouble here however and the mail carrier from Pouce Coupé to Fort St. John uses pack-horses to make the trip. Pine river can generally be forded at this crossing, but one must be well acquainted with the normal stage of water, as this is a mountain stream and consequently subject to frequent change in volume.

We arrived at Fort St. John on October 13, and immediately commenced to build a raft with which to travel down Peace river. On the 16th the twelve men left for Peace River Crossing, while I returned with my packer to pick up the remainder of the party and to take the outfit and horses to their winter quarters near Rolla.

We then proceeded to the mouth of Kiskatinaw river where we built a raft, and on October 23, left for Peace River Crossing where we arrived on the 28. We reached Edmonton on the 31.

The soil throughout the townships subdivided is composed of three to eight inches of black loam with clay subsoil. The land is quite suitable for farming purposes.

From May till the latter part of September luxuriant grass for stock is plentiful, and peavine in its season grows profusely. I have heard several settlers say that the upland hay is hard to cure and that there are few hay meadows. However, from the hay stacks observed by us throughout the Pouce Coupé district in the autumn of 1915 it would appear that no great difficulty is to be met with in procuring sufficient hay for stock. A heavy growth of grass is to be found bordering the numerous creeks which occur throughout the country and live stock will fatten rapidly upon it. The largest of these creeks never run dry so that fresh water can always be obtained.

The surface is in general rolling, and is usually covered with poplar from one to six inches in diameter and willow. Some spruce up to twenty inches in diameter grows in the creek valleys and the northern one-third of township 78, range 17, is

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covered with poplar, spruce, birch, and tamarack averaging eight inches in diameter. Much of the timber, however, in this area has been destroyed by forest fires. Flats of considerable extent are to be found above the slopes of Kiskatinaw river and also in the valley lands following Buffalo creek in the northwestern portion of township 77, range 17, and the southwestern corner of township 78, range 17, and also along Coal brook in townships 80, ranges 16 and 17. These plateau and bottom lands are very suitable for farming or ranching purposes.

Kiskatinaw river runs in a northerly direction through this district. It averages two chains in width and has a current of about three miles per hour. In average water its depth varies from three inches to twelve feet, and it is unnavigable either at this stage or in flood when it becomes a rushing torrent, filled from bank to bank with drift logs, and runs like a mill-race. It then averages from twenty-five to thirty feet in depth. Its banks vary in height from twenty-five feet in tp. 77-17-6, to nearly 300 feet in tp. 80-17-6, and the valley varies from three-quarters of a mile to a mile and a half in width.

The most suitable farming lands lie in the valley of Buffalo creek in townships 77 and 78, range 17, and along the valley of Coal brook in townships 80, ranges 16 and 17. There are patches of prairie up to twenty acres in extent along these creeks and the rest of the surface can be easily cleared, as the timber is nearly all small poplar and willow. Most of the northern two-thirds of township 77, range 17, the southern two-thirds of township 78, range 17, and the southern two-thirds of township 80, ranges 16 and 17, will furnish good farming land except where broken by Kiskatinaw river valley. A beaver meadow, from which a large supply of hay could be cut, is located in section 10, township 80, range 17.

Pouce Coupé prairie, which lies immediately to the east of these townships, consists of rolling and almost open valley lands in its northern and eastern portions and is bounded on the south by a high divide known as Bear hills. These hills are well timbered and will furnish fuel to the prairie for many years.

The farmers are prosperous, but the country is in great need of railway accommodation. It is being settled rapidly and by the time the railway has penetrated this fertile belt there will be few acceptable quarter-sections left vacant.

Vegetables of first-class quality are raised in abundance, and the land is well suited for the production of wheat and oats. In the autumn of 1915, a farmer living near Rolla post office in this district had yields of forty-two bushels of wheat, ninety bushels of oats, and twenty-seven bushels of flax per acre; this furnishes ample proof of the productiveness of the soil. Summer frosts damage crops some years, but this a feature common to all newly-settled districts and will most likely disappear in the course of time. In 1914 the potato crop was a failure due to summer frosts. The prairie is well watered by numerous large creeks.

Large game such as bears, deer, and moose were frequently seen. Rabbits are numerous, but partridges and prairie-chickens are scarce. Red and silver foxes are numerous, as are also beavers, and the homesteaders do considerable trapping on Bear hills and along Kiskatinaw river. Grayling, pickerel, pike, and sucker of small size and in limited numbers can be caught in Kiskatinaw river when the water clears after the July flood has subsided.

Some years there is scarcely sufficient rainfall, while in other years it is excessive. Settlers who are not located on one of the larger creeks have sometimes had to haul water from these creeks, but usually the supply from the smaller creeks is adequate for their needs, and by the erection of dams they can procure sufficient water for stock during the winter. Wells have to be sunk to a great depth before water is obtained.

The climate is usually very agreeable and I have been told by some of the settlers that some years they have been able to work in the fields without coats until well on in December.

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There are two post offices in the eastern part of Pouce Coupé prairie, but there is room for another in the west end, as it is fairly well settled; no doubt one will be established there soon.

Settlers going to Pouce Coupé prairie may now travel by train as far as Spirit River settlement. From there, a good wagon road leads south to Grande Prairie and thence northerly along Beaverlodge river to Pouce Coupé. A branch of the Edmonton Dunvegan and British Columbia railway is under construction from Spirit River settlement to Grande Prairie. It is expected to be in operation sometime during 1916.

APPENDIX No. 27.

ABSTRACT OF THE REPORT OF J. A. FLETCHER, D.L.S.

BASE LINE SURVEYS IN NORTHERN ALBERTA.

My instructions for the season of 1915 called for the survey of the 24th and 25th base lines (north of townships 92 and 96 respectively) from the Fifth meridian westerly to the east boundary of range 18.

Upon receipt of these instructions, arrangements were made immediately to have supplies shipped to caches in the vicinity of the 24th base line, one shipment to go by way of Athabaska and Wabiskaw to the intersection of Wabiskaw river and the Fifth meridian in township 91, and the other to go by way of Grouard, north to the neighborhood of Buffalo lake in townships 94 and 95, range 14.

Mild weather came very early in the season and by March 23 most of the snow had disappeared. This made the placing of the Buffalo lake cache impossible. These supplies were therefore ordered to be sent to Peace River Crossing, and arrangements were made on my arrival there to have the Hudson's Bay company take them down Peace river to the mouth of Wabiskaw river. The supplies for the other cache were sent to Pelican on Athabaska river and one small load was got across to Wabiskaw before Pelican river broke up. The remainder of this cache was later taken to Wabiskaw by pack-horses and canoes, and was then sent by canoe down Wabiskaw river to the vicinity of the eastern part of the work. During the handling of the goods they were considerably damaged by water.

All the supplies for the 25th base line survey were purchased in Edmonton, and along with the thirty-one pack-horses were loaded into two cars and shipped to Reno. The party and outfit reached Peace River Crossing on March 30. The weather continued so extremely mild that it was impossible to make the trip down Peace river by sleigh, and we were forced to remain at Peace River Crossing and await the open water.

Eight men were sent north to the 25th base line with the pack-horses, while the remainder of the party repaired the scow left at Peace River Crossing the previous fall. On April 17, the ice having disappeared, the trip down the river was commenced; the scow reached the 25th base line on the 19th almost simultaneously with the pack-train. The survey of this base line was commenced on April 22, and the work proceeded without interruption till the line was completed on July 27. We then moved toward the 24th base following the trail by way of Burnt lake. Where the old trails were not suitable, a fresh trail was made. The survey of the 24th base line was commenced on July 31, and proceeded continuously till its completion on November 2.

On November 3 the party commenced its return to Peace River Crossing. The tamarack swamps were not yet frozen enough to hold pack-horses and while following the trail along the east outline of range 18, the party was kept busy repairing and cutting fresh trail around the soft spots. The trail followed the east boundary of range 18 to the 23rd base line, thence westerly to Peace river, and then southerly in the vicinity of the river to Peace River Crossing, where we arrived on November 10. The next day the party proceeded to Reno, and on the 12th we took the train for Edmonton, arriving there on the 13th, when the party was paid off.

The Fifth meridian is distant 114 miles from Peace river at the 25th base, and in order to keep supplies up with the survey party, it was necessary to place a cache somewhere between these two places. After it was found impossible, through the disap-

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pearance of the snow, to place the cache on the 24th base near Buffalo lake, arrangements were made to have these supplies brought in by way of Wabiskaw river. Four canoes were accordingly secured, and five men were hired and placed under the charge of one of my assistants. On April 21, after sufficient supplies were left at the 25th base to last until the line reached Wabiskaw river, these men took the remainder of the supplies in the scow to the mouth of Wabiskaw river and freighted them up the river by canoe. By June 13 enough supplies to last the party to the Fifth meridian were freighted to a cache on Senex creek at the foot of the bad rapids in township 98, and about equidistant between the 25th and 26th bases. For the remainder of the 25th base, supplies were carried from this point by the pack-horses.

Owing to a pressure of their own freight, the Hudson's Bay company had failed to bring further supplies for me to the mouth of Wabiskaw river, as they had promised to do early in April. They also told my assistant that he would have to see to the handling of this freight in person, otherwise it would not be brought down at all. This necessitated a trip by him to Peace River Crossing to ensure receiving enough supplies for the remainder of the survey. These supplies were brought by the Hudson's Bay company's steamer to the mouth of Wabiskaw river, and freighted by canoe to the mouth of Loon river near the 24th base. There are rapids at short intervals most of the way up Wabiskaw river from its mouth. In low water these are quite noticeable and it is difficult to get a loaded canoe over them, the rapids in township 98 being the worst. The supplies from the cache at the Fifth meridian were moved down Wabiskaw river by canoe, about three weeks' supply being sent to range 2, and the remainder to range 4, where they were picked up by the pack-train.

Most of the land passed over will in time make good agricultural land, but in most sections settlement will be slow as there is no ready means of access. Wabiskaw river has too many rapids to make a cheap means of transport, and only in the very high water would motor or steam boats get sufficient depth of water to clear the rocks in the rapids. The country is readily reached by Peace river, but settlers could not very well get inland to suitable locations. The district is well timbered, but from time to time fires have broken out in different sections killing the trees. The lapse of a year or so leaves the surface a tangled mass of windfall. This windfall is quite general over Buffalo Head hills in ranges 10 to 14, and again on the 25th base east of Wabiskaw river.

Numerous small swamps with growths of willow, alder, and tamarack were seen throughout the district; these seem to be the result of old beaver floodings. Quite a number of new beaver dams and ponds were seen during the season, and in some sections the country is extensively flooded. Old beaver meadows are also numerous. Areas of moss-covered ground were quite frequently passed. In some places this moss is two or three feet deep, and where stunted spruce is growing, it does not thaw out all summer. The decayed moss underneath forms a peaty layer with enough moisture to stay frozen. I believe the district could all be suitably drained, and although there are some ridges of light soil, there is generally clay enough to make excellent farming land.

The country northwest of Buffalo lake is mostly level or gently rolling, drainage taking place to the northwest, and the surface is covered with alternate areas of spruce and poplar timber, tamarack swamp, windfall, and moss-covered lands. The soil in this district is generally a good clay or clay loam. On the western slope of Buffalo Head hills, which is quite gradual, there is some land lightly timbered with small poplar and supporting a good growth of grass; this would make good farming land.

The land on the Buffalo Head hills and to the southwest of Buffalo lake is generally rolling, some of the intervals between the ridges being covered with moss and stunted spruce. Most of this region is now covered with windfall or standing dead timber. Lakes and ponds are quite numerous. The soil is somewhat lighter than the lower ground, as indicated by second-growth jack pine on the ridges.

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The land between Buffalo Head hills and Loon and Wabiskaw rivers is quite level or gently rolling, and is well timbered along the 25th base with poplar and spruce. From township 94 south, extensive swamps are found with some low ridges of poplar and spruce. Some excellent prairie land covered with grass was found in township 93, range 8. The soil there is a good black loam and will make good farms. Closely adjacent to this fine land are flooded swamp areas which when drained would probably make equally good land. This flat land continues through range 7, adjacent to the 24th base line, and through range 5, adjacent to the 25th base line. The remainder of the country to the Fifth meridian is high rolling or gently rolling land, and is mostly well drained by creeks tributary to Wabiskaw and Panny rivers. The country is somewhat similar to that on Buffalo Head hills and most of it would make good agricultural land if the adverse surface conditions were removed. It is well timbered with poplar and some spruce through ranges 2 to 5, in the vicinity of the 24th base and Wabiskaw river.

Russell, Haig, Talbot and Rossbear lakes on Buffalo Head hills, contain whitefish, but Buffalo lake in the same locality is shallow and has no whitefish. Large flocks of ducks and geese stop to feed at this lake on their migrations north and south. Moose seemed quite plentiful in the district from Wabiskaw and Loon rivers westward to Peace river. Bears were occasionally seen and fur seemed plentiful, beavers, foxes, martens, lynx, mink, weasels and wolves being in evidence. Very few prairie-chickens or partridges were seen.

Some spruce of marketable value was seen along Wabiskaw and Loon rivers and some of the tributary creeks. This timber could easily be floated to the mouth of Wabiskaw river. In other sections there is sufficient timber for building, but on account of the extensively burnt condition of the country no large timber was seen in sufficient quantities to make milling profitable. No coal or minerals were found. Wabiskaw and Loon rivers have numerous rapids which might be developed for power should a market arise.

The climate during the season of 1915 was very fine, as is usually the case in this country. The rain was sufficient to satisfy all needs of growth, but was not excessive. The country was becoming quite dry in early July, and forest fires were seen in several directions. These, however, were stopped by some good rains about the 10th. About an inch of snow fell on September 10, while the party was at Loon river, and snow was quite frequent on Buffalo Head hills in October.

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APPENDIX No. 28.

ABSTRACT OF THE REPORT OF W. A. FLETCHER, D.L.S.

STADIA SURVEYS IN YORKTON DISTRICT.

The season's work consisted of the continuation of the stadia traverse and investigation of lakes and sloughs in the Yorkton district, and the establishment of monuments at corners where the presence of water had prevented their erection at the time of previous surveys.

Work was begun in tp. 27-14-2 on June 1, 1916, and the investigation, urgently required, of eight townships in this locality, was completed by the middle of September. We then moved to Pelican lake in tp. 32-10-2, and after completing the work in this township and in tps. 31 and 33-10-2, left for tp. 26-1-2, which we finished on October 30, thus completing operations for the season.

The district investigated this year presents much variety. In some townships all the road allowances are open and graded, while in others large water areas block up the roads, and as in many cases the land surrounding the water is low and wet, no attempt has been made to construct roads around the obstructions.

On the south side of Sandy lake in tp. 32-10-2, there occur large sand dunes, about six feet high, which have been thrown up by the wind and waves. These dunes are about eight feet wide on top, being grown over with willow and poplar. When the water in the lake is high it escapes through openings in the dunes flooding the land behind.

Poplar grows almost everywhere, but never to a greater diameter than six inches, except in small patches. The surface, which is level prairie to the south, becomes rolling farther north. The soil is good, though often very stony. Good crops are raised where the land can be easily cultivated, but in the stony and rolling areas where hay is abundant ranching is followed.

Small game, both of the fur-bearing and feathered varieties, is plentiful.

APPENDIX No. 29.

ABSTRACT OF THE REPORT OF L. E. FONTAINE, D.L.S.

INSPECTION SURVEYS IN NORTHERN ALBERTA.

My 1916 surveys were not commenced till late in the season. I reached Edmonton on August 11, and while my supplies were being prepared for shipment I proceeded to High Prairie to arrange for winter-quarters for the horses of the different parties operating in the vicinity of Lesser Slave lake.

On my return to Edmonton I organized my party, and on August 23 we left to inspect the townships subdivided by Mr. H. E. Pearson, D.L.S. This work was completed on September 6.

We then proceeded to High Prairie, and used this place as a base while inspecting the surveys of Messrs, D. F. McEwen, D.L.S., and A. E. Glover, D.L.S., which were located to the south and southwest. This work was completed on October 17.

From High Prairie we returned by train to Westlock in tp. 59-26-4, and thence travelled by trail to the townships surveyed by Mr. A. Lighthall, D.L.S., west and north of Holmes Crossing in tp. 61-5-5. The trail as far as Holmes Crossing is well graded and in good condition. We completed the inspection of this survey and arrived back in Edmonton on November 20, when the party was paid off.

Throughout the districts visited the soil is mostly fair, but except in isolated spots the land is more or less wooded and will require clearing. Improvements were noted everywhere and all of these districts have been benefited by the operation of the Edmonton Dunvegan and British Columbia railway, which gives access to the markets.

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APPENDIX No. 30.

ABSTRACT OF THE REPORT OF J. S. GALLETTY, D.L.S.

SUBDIVISION SURVEYS IN NORTHERN MANITOBA.

Owing to the wet nature of the district in which my work lay it was decided to postpone operations till late in the season. I left Pas with my party on August 4, 1915, and, travelling via Hudson Bay railway and thence across Cormorant lake by canoe, we reached our first work in tp. 60-24-Pr. south of Cormorant lake.

A portage one mile long connects this lake with Atikameg lake, but a creek can be used for three-fourths of the distance with lightly-loaded canoes. The shores of both lakes are high and rocky, and landing places are scarce.

By December 14 we completed the surveys in tps. 59 and 60-23-Pr. and tps. 58, 59, and 60-24-Pr., except the traversing. Leaving my assistant and three men to complete this work I went to Pas with the remainder of the party to perform some surveys in connection with Indian reserves and a settlement on Carrot river.

Completing this work on February 19, 1916, we began the subdivision south of Saskeram lake from range 26 to range 30 inclusive.

The townships between Cormorant and Reader lakes are easily reached from Pas by the Hudson Bay railway and thence by boat to the desired township. In winter there is a trail from Pas to Atikameg lake and from this the surrounding townships can be reached by travelling over the ice. Carrot river settlement can be reached in summer by steamboat, and in winter one could take a team to almost any lot yet surveyed with very little cutting.

Between Cormorant and Atikameg lakes the soil is nearly all fourth class, being usually rocky or swampy. In Carrot river settlement the soil is a first-class clay loam, the result of sedimentary deposit from the flooding of the rivers of the district. There are a number of lakes and marshes here most of which would permit of drainage into Carrot river when the latter is at low water. As clay appears in the bed of these lakes and marshes it may be assumed that the beds of such areas as would be reclaimed would become in time first-class soil also. There is practically no stone in this locality. The soil there will grow all the grains and vegetables grown in the province, and some of the products of the district which have come under my notice were very fine indeed.

Limestone is abundant between Cormorant and Atikameg lakes, and a few boulders of granite and gneiss were seen there also, but beyond this no mineral was found.

Game is not very plentiful, as we saw only a bear, a moose, some ducks and goose, and a few foxes and wolves; the district is too close to the railway and to civilization.

Scrub spruce, poplar, jack pine, tamarack and willow constitute the main growth between Cormorant and Atikameg lakes, and they cover the whole surface leaving very few open spots. Occasionally the timber gets larger, and along the shores of Atikameg lake a settler would find logs suitable for building. In tp. 59-23-Pr. there is a belt of timber which if given time would make a very nice limit. At present the timber is for the most part small but it gives indication of good growth and would be worth preserving. Spruce predominates but there is also some good poplar. Along Carrot river one finds a thick growth of willow which is partly replaced by balm of Gilead, maple, and ash as one ascends the stream. This growth is confined to a narrow strip along the river but ridges of thin willow extend between the lakes.

No hay could be cut in the townships between Cormorant and Atikameg lakes, but there are numerous hay meadows along Carrot river and in a dry season several

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thousand tons of hay could be put up. Almost every settler in Carrot river settlement would be sure of some hay land, for every lot contains some, and the yield is very large.

The climate does not differ much from that of other parts of the three western provinces of the same latitude. During last winter we were troubled with strong winds, as we were often working in the open, but in a bush country these would not be noticed.

I saw horses belonging to a settler on Carrot river, which passed the winter in the open, and they were in good shape in the spring. They were fed hay, but I saw them pawing in the frozen marshes. Last winter was generally considered a pretty severe one and it would therefore appear, that, given the right class of animal, horses and cattle could rustle most of the winter, or at least would only require to be fed hay during the winter months, and the settler would not be under the necessity of erecting costly buildings.

Fishing has been carried on to a considerable extent in Cormorant and Reader lakes, whitefish, trout, jackfish, and pickerel being obtained there, but these lakes are now somewhat depleted and no fishing is being done in them.

Cormorant lake is reached by the Hudson Bay railway which crosses the lake at a point called "the narrows" about forty-two miles from Pas.

The lake is about eighteen miles long and twelve wide, and is broken up by a number of large islands. The water is clear, potable and usually deep but in tp. 60-23-Pr. there is a shally stretch between some islands and the shore. The shores are rocky and in many stretches the limestone rises vertically out of the water to a height of from fifteen to twenty feet, and there the water is deep close to shore.

Atikameg lake is more popularly known in the district by the name of Clearwater lake, and is connected by a small stream to Cormorant lake. There is a fall on the stream of about twenty feet at Cormorant lake, but there was no water flowing last August. This lake is larger than Cormorant lake, and in the part surveyed it has only a few small islands. As a result of this a light breeze will raise quite a sea, which makes the lake dangerous for small boats. It is, however, quite safe for large power boats and sail boats. The shore is low, but stony with occasional sandy beaches, and the land rises gently as one goes inland. The water is deep, very clear and good to drink.

Carrot river is about three chains wide, and is navigable for about one hundred miles from Pas in high water, and for about fifty miles in low water. Four settlers were found there at the time of the survey, and on a recent trip to Pas, I found six more, who were waiting until the river was clear of logs, and who were coming to settle on the lands surveyed. The land there is liable to flood, but though the settlers know of this they are satisfied that in spite of that it will be worth their while to take up land in the district. The soil is first class with many fine open hay meadows, and except for the possibility of flood, there is everything to attract the settler. Summer frosts are few and their effect will be nullified when the land is broken up.

No coal or lignite is found in the district and we had difficulty getting a supply of dry wood, but a settler could overcome this by cutting his wood supply ahead of time and allowing it to dry.

Another item of interest to settlers is that a large new school has been erected at Pas, and it is the intention of the authorities to conduct a high school there in addition to the regular public school, when conditions warrant their doing so.

Mining has aroused a keen interest in the district northwest of Pas. Valuable deposits of copper sulphide have been found at Flin Flon lake and at Schist lake, while the gold discoveries at Herb lake and Little Herb lake are also considerable. Drilling is in operation on the Flin Flon properties and also at Schist lake. It is expected locally that this summer will see considerable development in the mining industry there.

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APPENDIX No. 31.

ABSTRACT OF THE REPORT OF JAMES GIBBON, D.L.S.

SURVEYS IN THE NEW WESTMINSTER DISTRICT.

My work for the season of 1915 was commenced in tp. 2, W.C.M., where preliminary surveys were made of parts of sections 9 and 20, with a view to subdividing them into small holdings later on. Part of the Vancouver Power company's right of way through this township was also surveyed. Most of the heavy timber has been removed from this township, but there is still sufficient light timber left to make the cutting of shingle-bolts, ties, wood, etc., fairly remunerative. The soil is best suited for mixed farming and gardening purposes.

On completion of these surveys we moved south to sec. 23, tp. 1, W.C.M., and began the survey into legal subdivisions of sections 14, 15, 17, 21, 22, 23 and 24. These sections are situated on a ridge from 200 to 300 feet in height between Nicomekl river tide flats and Semiamu bay. This ridge was originally thickly wooded with large cedar, spruce and other timber. The greater part of the fir and cedar has been removed by lumbering operations followed by heavy bush fires, but there still remains a considerable quantity of large fallen cedar which is being cut up into shingle-bolts. Small plots are being used for growing garden produce and small fruits but the work of removing the large fir stumps is too costly for the ordinary settler.

Our next work was to lay out secs. 17 to 21, tp. 7, E.C.M., into legal subdivisions. These sections lie on an extension of the ridge crossing tp. 1, W.C.M., and the land is similar in character.

On July 7, we moved back to tp. 2, W.C.M., where we completed the subdivision of the northwest quarter of section 20, and the southeast quarter of section 9, and on July 20, moved to tp. 14, E.C.M., where we surveyed section 36 into legal subdivisions. The latter section seems best suited for fruit growing. We also surveyed several small islands in Fraser river adjacent to the east boundary of the township.

Our next work was in the vicinity of Morris lake, in tp. 4-29-6. The Government has constructed a fish trap at the point where Morris creek flows into the lake for the purpose of securing salmon spawn to supply the Government fish hatchery on Harrison lake. The main industries of the district are fishing and lumbering but the soil seems to be well suited for fruit growing.

On August 24, we moved to tp. 3-29-6 where we resurveyed several islands in sections 15, 16, and 17 and traversed part of the south bank of Fraser river. These islands are formed principally of river silt and consequently the soil is especially suited for agricultural purposes. Apples, pears, plums, and the smaller fruits grow in abundance in this district and hop growing is one of the chief industries.

Our next move was to sec. 22, tp. 3-30-6 which was partly surveyed into legal subdivisions. This section is situated on a high rocky ridge between Harrison bay and Fraser river and very little of it is suitable for agriculture. From this camp we also traversed part of the south bank of Fraser river and several islands in the vicinity.

Camp was then moved to an island in section 10 of the same township, from where the traverse of the south bank of the river and adjacent islands was continued. Some of these islands are of little value except for pasture, as the deposit of silt on their surface is not yet very deep. From this camp we also surveyed the southwest quarter of section 16 into legal subdivisions.

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On October 15, the main party was disbanded, and assisted by one man only I completed the work in this vicinity. I then proceeded to tp. 22, E.C.M., where some of the section lines in the vicinity of the international boundary were retraced. This part of the township is rough and broken and is best suited for pasture lands.

On October 29, I closed operations and returned to Vancouver.

The lands in the vicinity of the lower Fraser river are mostly composed of alluvial soil and are very fertile. The district is also rich in timber. The canning of salmon is one of the chief industries, millions of pounds being put up annually. Salmon fishing is permitted for some thirty miles up Fraser river; above that the fish are protected in order that they may reach their spawning grounds. The spawn for the Government hatcheries is gathered from fish caught in traps. After the fish are hatched they are allowed to go free to re-stock the waters.

No coal or other minerals were found and no water-powers were noticed during our survey.

The climate in the district covered by my surveys is sufficiently moist to render irrigation unnecessary although the past season was exceptionally dry. The months from November to February inclusive constitute the rainy season.

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APPENDIX No. 32.

ABSTRACT OF THE REPORT OF A. E. GLOVER, D.L.S.

SUBDIVISION SURVEYS SOUTHWEST OF LESSER SLAVE LAKE, ALBERTA.

My work for the season of 1915 consisted of the subdivision of townships 71 and 72, ranges 20 and 21, and part of the township 72, range 19, all west of the Fifth meridian.

This district may be reached by either of two routes. One is the winter road from High Prairie, a station on the Edmonton Dunvegan and British Columbia railway, to Snipe lake, and thence northwesterly by pack-trail. The other route is from Aggie siding to Little Smoky river in tp. 72-20-5. The latter route was the one used by my party.

Before commencing the season's surveys I had a cache of provisions established at Aggie but as the trail from there to the vicinity of our work crosses a very flat country with poor drainage, and is consequently never in good condition in the summer, it was decided that it would be impossible to pack supplies in with our pack outfit. Arrangements were accordingly made to have all the supplies at this cache freighted to our first camp in tp. 72-20-5.

Another cache was established at High Prairie for use during the latter part of the season. This was entered during the summer and robbed of our most valuable supplies.

Work was commenced in the field on May 7, in tp. 72-20-5 and was continued without interruption till October 17, when the season's operations were closed.

All of the townships surveyed with the exception of tp. 71-20-5, are covered by a dense growth of spruce, poplar, willow, and alder. The soil is good and has good natural drainage for about ten miles on each side of Little Smoky river. The land is fairly level with the exception of the river valley which is rough.

The surface of tp. 71-20-5, is lightly wooded with willow, alder, and scrub poplar, with many open spaces. It will make excellent agricultural land and will be easily cleared. There are no settlers in this district yet.

Game, such as moose and bears, is very plentiful.

No summer frosts were noticed.

APPENDIX No. 33.

ABSTRACT OF THE REPORT OF R. V. HEATHCOTT, D.L.S.

SUBDIVISION SURVEYS NORTHWEST OF PEACE RIVER CROSSING.

My work consisted of the subdivision of townships 85, ranges 24, 25, and 26, west of the Fifth meridian, and townships 83, 84, and 85, range 1, township 83, range 2, and the northerly one-third of township 82, range 2, all west of the Sixth meridian.

From Peace River Crossing we proceeded by the Dunvegan wagon road as far as the Catholic mission, in tp. 82-23-5, thence by the Whitemud wagon road around the east end of Bear lake and thence northerly into the southeast corner of tp. 85-24-5. This is the best route into this township and the townships west of it. The shortest route into the other townships subdivided by me is the Dunvegan wagon road to Bear Lake post office in tp. 83-24-5, and thence northwesterly to the west end of Bear lake, where the road branches, one branch going north into tp. 85-26-5 and the other due west; both of these are good.

My outfit consisted of two heavy teams and fifteen pack-ponies. The teams were used for bringing in supplies and moving the main camp, and the pack-ponies for moving camp and also for taking fly camps to finish the portions of the work farthest away from the main camp, thereby saving considerable time in cutting trails. We were able to use wagons all through our work, being fortunate in finding roads which required comparatively little work to open up.

After completing the survey of tp. 85-24-5, we worked west to tp. 85-1-6, and then south, finishing in tp. 82-2-6.

The country is gently rolling, and most of it has been burned over and is now covered with light bush. The remainder is heavily timbered, excepting the northern portion of tp. 85-1-6, which is heavily rolling and forms part of the Whitemud hills.

There is plenty of water in the numerous small creeks, and in the shallow lakes, of which there are a large number in tp. 83-1-6. The soil consists of black loam with a good clay subsoil, and is most suitable for mixed farming. It will probably be very rapidly settled, though there were at the time of my survey only six squatters, these being located in tp. 83-1-6; one of them had a fine crop of oats.

The country immediately to the south and east of this district is known as the Bear Lake settlement. It is well settled, and grain growing and market gardening have been carried on with marked success.

We completed our work on September 30, and proceeded to Edmonton, where the party was disbanded.

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APPENDIX No. 34.

ABSTRACT OF THE REPORT OF G. H. HERRIOT, D.L.S.

BASE LINE SURVEYS IN NORTHERN MANITOBA.

My instructions for the season of 1915 called for the survey of part of the 15th base line (north of township 56) west of the Principal meridian, but owing to the wet nature of the country crossed by this line, it was decided not to begin work until after the freeze-up. Supplies for the work were cached at suitable points during the summer and the party was organized at Pas on November 10.

The survey of the base line was begun at the NE. cor., tp. 56-25-Pr., but the line of levels run in connection with the survey had to be commenced at a point about seven miles farther west.

It was therefore necessary to organize a small advance party to do this work. Accordingly on November 11, the third assistant with three men and two dog trains and drivers were sent out to commence this line of levels, and several days later the main party proceeded to the starting point of our regular survey work.

On November 16, the production eastward of the 15th base line was commenced from the northeast corner of township 56, range 25. Although the first twenty-four miles of our work consisted of resurvey, it was found that within the first range we had passed completely out of the old cutting. The country throughout these ranges is largely an extensive willow swamp, the willow in places being large and very dense, and in other places small and scattered. Where the willow were small, little or no trace of the old line could be discerned, and where they were large, the fact that the old line had been poorly opened out, and the willow that had been cut had been allowed to hang up in the others along the side of the line, meant that our line which ran along the north edge of the old line, was much harder to open than if the survey had been original.

Throughout the first part of the season, the supplies and dog feed were for the most part hauled from Pas, but whenever fish were available on Saskatchewan river closer than the town, we took advantage of the opportunity and purchased them for the dogs. Most of the dog feed used on this first section of the line consisted of corn-meal and tallow, as fish in quantities was not available. The dogs during this period steadily lost flesh, owing to the unsatisfactory food, and to the fact that they were still soft.

The production of the base line was continued eastward with the utmost expedition, until on December 3, it was discontinued in section 36 of range 20. The following day the east outline of range 21, was turned off to the north and its survey commenced. On the 13th we moved north to the 16th base, and next day turned the east outline of range 21 off that base to the south, and commenced its production southward. The work of extending this line across township 59 and part of township 60 was rapidly carried on owing to the extensive open swamps met. On December 20 the outline was completed and the camp was moved back to the 15th base in range 19.

On the following day the survey of the base line was resumed and the work carried forward with all possible speed until, on February 29, our survey was connected with the NE cor. sec. 35, tp. 56-4-Pr. on the eastern side of Playgreen lake

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Throughout the period of the survey extending from about December 10 until about January 22, we drew our supplies from a cache which had been placed at Moose Lake post. From the latter date until we arrived within hauling distance of Playgreen lake we hauled our supplies from caches on Limestone bay.

Throughout the period from December 1, until the conclusion of the survey, fish were used entirely for dog feed. Most of the fish were hung whitefish that had been put up for me at points on Moose and Playgreen lakes. The hung fish have a great advantage over green fish for dog feed, especially if there is any haul; they are much lighter and seem to contain greater nourishing qualities. However, an occasional change to green fish is to be recommended as it keeps the dogs in a healthier condition. The dogs at once began to improve and at the close of the season, with one or two exceptions, were in excellent shape, in spite of their hard season's work.

Weather conditions throughout the first part of the season, until January, were very fine for survey work. The snowfall was heavy enough to afford good trails but not so deep as to interfere with the progress of the work, or to necessitate the use of snowshoes. But from early in January until the end of February, the weather was very severe, the temperature ranging around 40 to 50 degrees below zero for several days. The depth of snow steadily increased so that early in January most of the line men were compelled to use snowshoes. Strong winds were very prevalent throughout the months of January and February, repeatedly filling up our trails. However, notwithstanding the severity of the weather and the frequent storms, we did not lose a single day on the line.

Description of the country traversed by the survey.

An extensive willow swamp with practically level surface extends across the easterly five miles of range 24; the soil is black loam and the ground is very springy. To the east of this swamp are some jack pine ridges and farther east in range 23 are more swamps which are impassable in summer. North and south of these swamps, however, are extensive jack pine ridges. Lakes are numerous along the line as far east as range 22 and in this range are ridges of clay loam and boulder clay. From there to Moose lake in range 21 the surface is low. This low land is flooded at high water, but it will probably be only a few years till this area will be marsh land. Near the shore of the lake is a bluff about thirty-six feet above the surrounding land. It consists of gravelly clay on limestone, on which grow spruce, poplar and jack pine up to ten inches in diameter.

Moose lake is of such an extent and so irregular in contour that it almost defies description. However, a few general remarks can be made. It is as a rule, quite shallow with deep areas in only a few places. Whitefish, jackfish, and sucker are to be caught in its waters, but only fishermen who are familiar with the waters were successful in making a fair catch last winter. The most easterly arm of Moose lake in range 16, is well known for its fine lake trout and large whitefish, but Government restrictions had closed this area of the lake throughout last winter. The lake may be considered to be made up of four different sections: the two main sections lying one north of the narrows, which is just about two miles north of the base line in range 19, and the other south of the narrows. The northern section extends almost twenty-two miles north, in ranges 19 and 20, with a width varying from four to ten miles. The southern section extending in parts nearly fifteen miles south, is roughly, the shape of the bottom of a bag with a huge triangle extending into it from the north for a depth of about seven miles. East of this projecting point lies the eastern arm. Its shape is roughly that of a rectangle, four or five miles wide and probably sixteen miles long. It is connected with the main lake by a channel only a couple of chains wide, through which a very marked current flows. The westerly arm which we first encountered in range 21, is quite irregular in shape and is perhaps shallower than any of the other

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sections. It is about seven miles across each way and is connected with the main lake by a channel less than a quarter of a mile wide. A number of very densely-wooded islands occur throughout the lake; one especially large one, lying about eight miles south of the base line in range 19, has been set apart as Indian Reserve No. 31 C.

The part of the base line across ranges 20 to 16 is therefore badly cut up by the various arms of the lake. The intervening peninsulas are mostly well timbered with spruce which in places is from eighteen to twenty-four inches in diameter. Most of the good timber is included in timber berth No. 1108.

Egg lake lies north of the line in range 17. It extends about eighteen miles northerly from the base line, and is about eight feet higher than Moose lake which is within a quarter of a mile of it at one point. Whitefish are very plentiful in it.

In ranges 15 and 14 the surface is slightly rolling and mostly covered with fire-killed timber.

Igneous boulders were occasionally met with in range 14, although no such rock was anywhere found in place. Here a most peculiar phenomenon of holes in the limestone bedrock occurs. The holes are from four to six feet deep with more or less circular and enlarged bottoms. The walls are quite firm, fairly perpendicular, and not at all weathered. The limestone here is lying perfectly flat. Quite a few of these strange holes were seen, occurring singly and in groups close together. From their formation it would appear as though water had been imprisoned at the time of some fire and that the intense heat had converted the water into steam which produced an explosion and blew out the limestone, thus creating the holes.

William lake in range 13 extends about eleven miles south of the base line and about thirteen miles north. The shore is rocky and rises considerably above the water level. The water was low at the time of our survey and fish were not plentiful. East of this lake spruce and jack pine muskegs are numerous with intervening ridges. These ridges are in reality, terraces of a long gentle slope towards lake Winnipeg. The fall at each of these steps is approximately twenty feet, while the muskegs also have a gentle slope eastward.

Limestone bay lies about a mile south of the base line in ranges 9, 10, and 11. It is an extension of lake Winnipeg and is very shallow, being not more than five feet deep at any point.

From there to Playgreen lake in range 5 the surface is level and consists principally of tamarack and spruce swamps.

Playgreen lake is really an expansion of Nelson river. It is about fifty miles long and roughly four miles wide. This lake is connected with lake Winnipeg by about a three-mile stretch of Nelson river. Numerous small rocky islands appear above the surface throughout the lake, while many do not rise high enough to form islands but occur as submerged reefs. The water is generally very shallow. From these facts it is apparent that only shallow-draft boats can be used on the lake and then only with a pilot thoroughly acquainted with the reefs. No attempt whatever is made to travel the lake at night. The Northern Fish company's boats that have been navigating Playgreen lake are screw boats with a draft of less than six feet, and not infrequently they run aground. This body of water is traversed by boats running between Warren Landing south of the base line, and Norway House and Whiskey Jack portage north of it. Whitefish, sturgeon, jackfish, pickerel and sucker are very plentiful in the waters of this lake.

The country along the east outline of range 21, between the 15th and 16th base lines is largely willow swamp with patches of spruce and tamarack. A ridge of dense timber, consisting of spruce, balsam, jack pine, poplar, and birch up to ten inches in diameter extends along the north shore of the west arm of Moose lake in township 57.

The country in the neighbourhood on the 15th base line is easily accessible. The eastern end of the line may be reached by boat across lake Winnipeg to Warren Landing and thence down Nelson river and Playgreen lake. Ranges 10 and 11 can be reached

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by boat from Warren Landing to Limestone bay. The western end of the country covered by our survey is within easy reach of Pas, Manitoba, and the district in the vicinity of ranges 21, 20, 19, 18, 17, or 16 can be readily reached by travelling by boat or canoe down Saskatchewan river from Pas to Moose lake. The country in the vicinity of the east outline of range 21, in townships 59 and 60 is within easy reach of the Hudson Bay railway at Cormorant narrows.

Resources of the country.

The resources of the country covered by our surveys are very few indeed. Practically none of the land will be suitable for cultivation until after it is drained. Where the land is already sufficiently dry, the soil is a clay, carrying limestone fragments, which makes it unsuitable for growing crops.

Certain areas bordering on Moose lake however would be suitable for stock raising as the growth of slough grass over these sections in 1915 was quite luxuriant, but a great portion of this area is liable to be badly flooded during high water. At Moose Lake post the trader keeps quite a number of cattle and horses. The Indians also have a few head of stock. It is necessary to put up an abundant supply of this slough grass for winter feed and to stable the stock in the winter as the weather is too severe to allow them to run at large, and the frozen grass on the swamps has little or no nourishment, besides being covered by two to three feet of snow.

Very little merchantable timber was met with during the survey. That included in timber berth No. 1108 has already been mentioned. A small island in William lake that has escaped the recent fire carries some fine spruce. A fringe of fair spruce timber borders Limestone river in range 11 at about eight or nine miles north of Limestone bay, but I have no information as to the probable extent of this patch of timber. Some very fine belts of timber suitable for pulpwood are to be found, especially around Moose lake. The fire of 1915 has destroyed great quantities of timber that would have made excellent pulpwood.

Of the many lakes in this locality, Moose and Egg lakes are the only two in which commercial fishing is carried on. Quite a number of tons of whitefish were taken last winter on Moose lake. Those caught in the northern part of the lake were hauled to the Hudson Bay railway at Cormorant narrows and shipped into Pas, while those taken on the lower part of the lake were hauled by teams to Pas. Only two or three fishermen were engaged on Egg lake, and from all reports they had a fair catch. These fish are also shipped to Pas. Fishermen who have fished on Moose lake for a number of years claim that the size of the catch taken on this lake is getting smaller each year. Whether this be due to depletion of the fish in its waters through fishing or to the dying off of the fish, owing to the lowering of the waters of the lake, is uncertain, but it is certain that the water level has fallen two feet or more since 1911.

Fur-bearing animals are by no means plentiful throughout any portion of the district traversed, although a few local sections were crossed where one or two kinds of fur-bearing animals were apparently numerous. Signs of foxes, lynx, beaver, mink, marten, wolves, both timber and brush, and weasels were observed. In the district north of Limestone bay signs of lynx were frequently seen.

Moose are quite numerous around Moose lake and northeast of Limestone bay, while the snow between Moose and William lakes was much tracked up by caribou. Rabbits, ptarmigan and partridges were very scarce.

Settlement.

Three small settlements lie within a few miles of the base line. The first of these at Moose Lake post is probably located in range 20 at about ten or twelve miles south of the base line. It comprises Indian reserve No. 31 on the west shore of Moose lake and the land occupied by a few squatters. Both Revillon Bros, and the Hudson's Bay

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company had posts here, but in recent years these have been closed up. A trader who owns a small store keeps quite a number of horses, cattle, and pigs. Two schools are conducted at the post, one for the non-treaty Indians and white children, and the other for the treaty Indian children. A fire ranger is also located here throughout the summer.

The trader and the Indians have made little or no attempt at cultivation of the land, although they have small gardens and are able to raise some of the hardier vegetables, such as potatoes, cabbage, lettuce, peas, and radishes. I believe that if the land were cleared, drained and cultivated, excellent oats and barley could be grown.

Near the eastern end of the base in range 3, Norway House, with the adjoining Indian reserve No. 17, and Rossville mission, lies about eight miles north of the line. Several trading stores are conducted here. Norway House with its location on Nelson river and Little Playgreen lake is a very picturesque spot. Moreover, it is historically important as it stands on the old route between Hudson bay and the interior of western Canada. An English church and Methodist mission look after the moral welfare of the Indians, and the Methodist mission with the aid of the Government, has erected a large boarding school for the Indians. A very fine hospital has also been built. The native population hunt, trap, and fish for a living during the winter, and in the summer those that are willing and able to work find employment around the missions, the trading stores, or in freighting or tripping on Nelson river. Little attempt has been made at agriculture, and only enough garden produce is grown for local needs. All the hardier vegetables can be grown.

In range 4, about thirteen mile south of the line, Warren Landing is situated. This is nothing more than a fishing and freighting station. It is situated at the north end of lake Winnipeg at the point where Nelson river flows out of the lake. On each side of the mouth of the main channel of the river is located a dock, fish-house, ice-house, and warehouse together with the different buildings for the fishermen, including dining and sleeping quarters. For about two months in the summer this point is a busy place, alive with men. During the remaining months of summer there is a stir only when the lake boats from Selkirk arrive with their passengers and freight. A few families of half-breeds live near the landing. These are employed during the summer, handling the freight from the boats, and in the winter months, they hunt and trap, and assist with the putting up of ice for the following summer. No attempt has been made to cultivate the land, which is found to be largely muskeg after one gets back from the sandy margin of the lake. Very little garden produce has been grown here.

On March 8, 1916, we commenced the retracement of the 15th base line westward from the NE cor. sec. 36, tp. 56-25-Pr. The line had been partially opened in the fall in order that we might carry our levels from the Hudson Bay railway to the point of commencement of our original survey, so that it was not necessary to do much further opening across range 25, nor was it necessary to run levels again over this section of the line.

Rapid progress was made on the survey as the line crossed two extensive open stretches on Reader and Saskeram lakes. Here the transport outfit was very busy as we moved camp every day. On March 20 we completed the retracement as far west as the Second meridian, and the following day returned to Pas.

APPENDIX No. 35.

ABSTRACT OF THE REPORT OF E. W. HUBBELL, D.L.S.

INSPECTION SURVEYS IN NORTHERN ALBERTA.

My field work, which lasted from early in September till the beginning of December, consisted of the inspection of subdivision surveys bordering on Athabaska river north of McMurray and along the right of way of the Alberta and Great Waterways railway south of McMurray.

Leaving Athabaska on September 16, we travelled down Athabaska river by scows reaching McMurray on the 22nd.

The celebrated tar sands cover a large area along Athabaska river, commencing at tp. 87-14-4, and extending about seventy miles north of McMurray; they are very conspicuous in places, especially at the mouths of rivers and creeks. Up to the present no development work on the tar-sand district has been undertaken, and it is therefore impossible to estimate the value of these immense areas, which authentic reports place at 700 square miles.

McMurray is beautifully situated between Athabaska and Clearwater rivers. Its population varies from 250 to 400. There are several good stores, three boarding-houses, one hotel, a Roman Catholic mission, post office, telegraph office, Hudson's Bay Company post and a portable saw-mill which has an output of from 8,000 to 10,000 feet per day.

North from McMurray, the river broadens out, the banks become gradually lower, and there are no rapids, although for fifteen miles the current is quite swift, being from five to six miles per hour. Many islands, mostly wooded, are met with and also numerous sandbars.

On September 28, we commenced the inspection of Mr. J. C. Baker's subdivision, finishing on October 5. No settlers were found in this district, except at McKay and vicinity, where there are a number of half-breeds and a Hudson's Bay post. From there we moved camp to tp. 101-9-4, and commenced the inspection of Mr. J. W. Pierce's subdivision, finishing on October 9.

Returning by boat to McMurray we moved by trail to tp. 88-7-4, where we commenced the inspection of Mr. Knight's subdivision and from there worked southerly into Mr. Waddell's survey, closely following the grade of the new Alberta and Great Waterways railway; the latter inspection was finished on November 17.

The country along this railway is mostly muskeg covered with small tamarack and spruce. There are however numerous ridges and isolated patches of good land, which are covered with spruce, poplar, birch, jack pine, tamarack, windfall, brule, and scrub. Plenty of good water is to be found in the small rivers, creeks and lakes. Very little hay land was noticed; in fact it is rather difficult for horses to obtain sufficient fodder in the summer, for their sustenance. Only a small percentage of the timber is adapted for manufacturing purposes, but there is plenty suitable for railway ties, fence rails, etc. When the railway is completed, transportation to McMurray and vicinity will be comparatively easy and much cheaper than at present, and the present water route will be abandoned.

The soil in the timbered areas consists of vegetable sandy loam, with clay subsoil, apparently suitable for agricultural purposes, although considerable clearing is necessary before it can be rated as land fit for cultivation. Game is plentiful, especially moose.

There are no settlers throughout this district, and until the muskegs are drained there is but little chance of there being any.

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APPENDIX No. 36.

ABSTRACT OF THE REPORT OF J. H. JOHNSTON, D.L.S.

SUBDIVISION SURVEYS EAST OF PEACE RIVER CROSSING.

My survey operations during the season of 1915, consisted of the subdivision of the north third of township 82, and all of townships 83, 84, 85, 86, and 87, range 19, and township 84, range 20, all west of the Fifth meridian.

I left Peace River Crossing, where my party was organized, on May 10, and proceeded by way of the Grouard trail to "Little Prairie", a distance of thirty miles; the road had just broken through and was in bad shape. From there we went north to township 82, range 19, on a trail which I had previously made in order to freight supplies from Reno. This trail which follows the north branch of North Heart river, passes through some very fine open country. This is a continuation of the "Little Prairie" district, the soil of which, according to tests of the Provincial Department of Agriculture, is among the richest in Alberta.

The first camp was in section 26, township 82, in open prairie, where the new grass was growing very rapidly. I brought with me thirty-five bushels of oats, which with careful distribution lasted until the grass was more abundant, and the pack-horses, twenty in number, were in fine shape for the season's work.

From there we worked north through range 19, and then returned to tp. 84-20-5, which was completed on October 20. In addition to the regular subdivision, levels were run along every alternate section line throughout the townships surveyed.

Through May and June the weather was very favourable for work, but through July heavy rains were experienced, which interfered somewhat with the progress of the work. By the time the work was completed on October 20, the weather was getting quite frosty and light snowfalls were experienced.

All of the townships subdivided are drained to the northwest by streams running into Peace river, except township 82, which drains to the southeast into North Heart river. Townships 86 and 87 are drained largely by Cadotte river which flows northwesterly into Peace river. Its bed is full of boulders and forms almost a continuous rapid from its mouth to range 19. Through this range and eastward, it is about a chain and a half wide; the rapids are less numerous and the current somewhat sluggish, meandering considerably in a more or less direct valley. Numerous beaver workings, some hay meadows, and a few small patches of spruce characterize this valley. The flats in the valley are mostly open, with an abundance of luxuriant grasses, peavine, and vetches.

In townships 83 and 84, there are several small shallow lakes which have no outlets, and there is considerable muskeg, although the levels show that there is plenty of fall for good drainage. The remainder of these townships and the other townships subdivided, especially townships 86 and 87, are covered with light bush, mostly poplar, with numerous sloughs, and open meadows covered with a heavy growth of grass. This land is quite suitable for agriculture.

During the season, several moose and bears, both brown and black, were seen. Foxes and coyotes were observed several times, and beaver and muskrat workings were seen in many places on Cadotte river. Ducks and geese were in great numbers on Runaway lake, in township 86, during August and September.

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APPENDIX No. 37.

ABSTRACT OF THE REPORT OF W.-J. JOHNSTON, D.L.S.

SURVEYS IN THE KAMLOOPS DISTRICT.

Having completed the organization of my party, I left Revelstoke on April 19, 1915, and proceeded to tp. 18-8-6, where my first work was located. This lay on the Mabel Lake wagon road about five miles east of Enderby.

The work in this township consisted of the survey of the north boundary and the subdivision of the northern tier of sections. The north boundary is crossed by Brash and Ashton creeks, which have narrow valleys about 2,000 feet below the level of the surrounding hills. A large portion of these sections is fairly good grazing land, covered with scattered fir and pine.

On completion of this work we moved to tp. 18-10-6, where the boundaries of a legal subdivision were surveyed.

On May 17, we commenced subdivision in tp. 19-10-6. This township has practically all been reserved for the protection of the water supply of the town of Salmon Arm. I was asked to investigate the land to ascertain its suitability for this purpose and I found that a large portion under reserve drained to the eastern slope, and could not be utilized. About sixteen miles of subdivision were run in this township.

Our next surveys were made in tps. 21 and 22-10-6. The work in these townships consisted almost entirely of cutting legal subdivisions and portions thereof out of timber limits. This was done in order to prevent settlers claiming ignorance of their boundaries, and encroaching on the limits.

Good wagon roads exist in all these townships, and I was able to use wagons, hired locally, for all camp moves, with the exception of one fly camp in township 20, range 9.

As a general rule the land is timbered with fir, pine, and cedar, with a thick underbrush, though in many places fires have passed through in recent years.

Rapid progress is being made by the settlers in improving their lands, and I think that eventually fruit growing will be the principal industry of the country.

On July 5, we moved by wagon across Shuswap lake on the Government ferry to tp. 23-11-6. This lake is one of the prettiest in British Columbia and may be rightly named "A sportsman's paradise." A fine Government wagon road runs easterly along the north shore, from the wharf near Scotch creek to a few miles beyond Celista in tp. 23-10-6. Another wagon road runs northwesterly from Celista up Meadow creek as far as sec. 23, tp. 23-11-6. The greater part of this township is mountainous, though some good bench land was surveyed along Scotch creek and in the southeasterly quarter of the township. Part of the boundary of Little Shuswap I.R. No. 4, was retraced.

A few miles of subdivision were also run in township 23, range 10. This township is rapidly becoming one of the best farming communities in British Columbia, not only for general farming but for fruit and berries as well.

Our next work was in tp. 22-12-6, where we were employed until September 10. Part of the boundary of Little Shuswap I.R. No. 1, was retraced and all the land lying north of the reserve was subdivided. Some good grazing land was surveyed, but the township is handicapped by lack of water.

The next work consisted of miscellaneous surveys in tp. 22-7-6, tp. 23-6-6, and tp. 23-4-6. This necessitated from two to three days' surveys in each township, and the work consisted principally of cutting small portions out of timber limits.

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Malakwa, in township 23, range 6, is fast becoming noted for its celery. Last year's provincial reports classified the lands there as the finest celery lands in British Columbia. The soil is black, oily loam with a sandy subsoil. Vegetables are grown in abundance but this year there is no market for them.

On September 21, we moved to Revelstoke, and commenced surveys in tp. 23-2-6. This work consisted of surveying two sections into legal subdivisions.

Columbia valley is being settled very rapidly and great progress is being made in its development. A large number of Austrians, Hungarians and Italians are found among the settlers. This district is likely to become one of the greatest apple districts of the province. It has a cool climate which produces a firm and tasty apple. Practically all kinds of farming are carried on, and small fruits and vegetables are grown in abundance. It has been found that corn will grow well. A large portion of the valley is still held as timber limits, but portions of these, suitable for agriculture, are being withdrawn as rapidly as possible by the Dominion Lands Agent, and thrown open for settlement.

On September 29, we moved by wagon to tp. 24-1-6 where we spent the remainder of the season. This is practically a new township as far as settlement is concerned. Some very fine land lies along both sides of Illecillewaet river, though a portion of it is still held as timber limits. Owing to the presence of glaciers, frosts occur earlier than at Revelstoke, but grain growing and mixed farming can be carried on profitably. The valley does not exceed two miles in width, and has a gravelly subsoil.

Deer are fairly plentiful throughout the townships covered by our surveys and quite a number of bears were seen. Fishing is good early in the season in Shuswap lake and in the small creeks.

Practically no mining or prospecting is carried on.

The season was the wettest which I have experienced in the past four years. In July we had five days of steady rain, and May and June were also wet; as a result of this there were very few fires and what fires did occur were very small.

APPENDIX No. 38.

ABSTRACT OF THE REPORT OF R. H. KNIGHT, D.L.S.

SUBDIVISION SURVEYS IN NORTHERN ALBERTA.

The survey work done by me during the past season consisted of the subdivision of tps. 81, 82, 83, and 84-6-4, and tps. 84, 85, 86, 87, and 88-7-4, lying along the line of the Alberta and Great Waterways railway.

We left Athabaska on May 11 and, with twelve tons of supplies loaded on three scows, floated down the Athabaska to McMurray.

Our trip down the river was uneventful except for the usual difficulties encountered at the various rapids. We camped one night at the Pelican company's gas wells, a few miles below Pelican rapids. Three wells had been drilled at this point, and I was informed that their combined capacity was estimated at seven million feet per day.

Survey operations were commenced on May 21, at the junction of Christina and Clearwater rivers in tp. 88-7-4. The valleys of these rivers are about 500 feet deep, and the banks are rough and covered with timber from twelve to twenty-four inches in diameter, mostly poplar, with scattered patches of spruce. Clearwater river has an average width of about seven chains, and a current of about three miles an hour. The valley is about a mile wide with the river flats mostly on the south side of the river. The valley of Christina river is narrow with steep broken sides.

Besides these two rivers, four other streams were crossed by our survey lines during the season. Gregoire river drains Gregoire lake in townships 86, ranges 7 and 8, and Little Pembina, Meadow, and Kettle rivers rise in Little Rocky mountains and run easterly into Christina river. These streams average from forty to fifty feet wide, and abound with jackfish during the early part of the summer. The only lake of importance is Gregoire lake which is about ten miles long and four miles wide. The water is fresh and clear and contains an abundance of whitefish and jackfish.

While travelling along Clearwater and Athabaska rivers, in the vicinity of McMurray I noticed that both of these streams cut into the limestone formation which appears to have a dip about equal to the fall of the streams. From this it would appear that there is a decided depression in the limestone near the junction of these two streams. This is further borne out by the fact that Horse and Hangingstone rivers, both of which flow through the limestone formation, join the other rivers within a short distance of their junction.

The townsite of McMurray is located at the junction of Athabaska and Clearwater rivers, on a large level plateau about thirty feet above high water, and between the two streams. The population at the beginning of the survey numbered about 300 persons, mostly of Canadian birth.

The northern and southern portions of the district covered by my surveys are largely swamp or muskeg, covered with a thick growth of young spruce. The dense growth is apparently due to the fact that the muskegs are fairly dry. The central portion of the district is rougher and more rolling and is covered with heavier timber. Most of the high land in townships 83 and 84, range 6, has recently been overrun by fire, and the timber is nearly all fire-killed. The dead timber averages from eight to twelve inches in diameter. The soil on the ridges is mostly clay or sandy loam.

The only trail in this district, previous to the advent of the railway, was the Lac La Biche-McMurray pack-trail. The railway contractors cut out a wagon road following as closely as possible along the right of way of the new railway but this road could not be constructed through township 87 and the southerly four miles of township 88,

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range 7, on account of muskegs and swamps. Consequently it follows the north side of Gregoire lake, and thence runs in a northwesterly direction, following approximately the old Lac La Biche pack-trail until within about eight miles of McMurray. It then strikes easterly and again joins the right of way in section 20, township 88, range 7. A wagon road has recently been opened through to McMurray along the old Lac La Biche pack-trail.

The season was, on the whole, dry, although four days of continuous rain was experienced in the early part of July. The first snow fell on September 11, and disappeared the following day. The first heavy frost was on the night of September 5, although light frosts occurred several times during the summer. Flurries of snow were frequent from September 11 until we ceased work, the heaviest occurring on October 30, when fully eight inches fell.

According to reports there is an abundance of small fur-bearing animals along the numerous streams. Coyotes and foxes seem to be plentiful. Moose is the most important of all game and is the only kind of fresh meat to be had in that country. The new railroad will open up one of the best moose-hunting grounds to be found in America. We closed operations on October 26 and returned to Edmonton reaching there on November 6.

APPENDIX No. 39.

ABSTRACT OF THE REPORT OF P. M. H. LEBLANC, D.L.S.

SUBDIVISION SURVEYS IN THE VICINITY OF FORT VERMILION.

Owing to the difficulty of access to the Fort Vermilion district, it was arranged that my party should remain in the field from the spring of 1914 till the autumn of 1915.

I left Edmonton on April 7, 1914, travelling by the Edmonton Dunvegan and British Columbia railway to Sawridge, and thence by teams to Peace River Crossing. From there we proceeded by scow to Fort Vermilion, reaching there on May 3.

My work in this district consisted of miscellaneous subdivision extending along the valley of Peace river from tp. 108-5-5 west as far as tp. 108-18-5, and also a portion of Wabiskaw valley in tp. 103-9-5 and tp. 104-10-5.

During the first part of the season the ground was frozen so hard that it was impossible to mound the lines run, and it had to be done later in the season. Also the mounding of the lines run late in the fall and winter had to be done after the spring thaw. This hindered the progress of the survey as it necessitated going over some of the lines twice. The traversing of Peace river and other large bodies of water was also left until the ice had formed.

We surveyed some Indian reserves and Hudson's Bay Company's reserves making the boundaries as far as possible coincide with the township subdivision lines.

We closed operations on September 29, and after making arrangements for wintering the outfit, left via Peace River Crossing for Edmonton, where we arrived on October 21.

The country passed over during the course of my surveys may be described as level, except where broken by the banks of the different rivers and creeks. It is generally covered with poplar up to twelve inches in diameter, willow, and spruce, but the latter is not in sufficient quantity to warrant its being reserved, though it will be found very desirable for settlers' use. A few patches of prairie, and large scrubby openings suitable for settlement were seen. On the slopes of Buffalo Head hills in tps. 101 and 102-10-5, areas of good spruce timber were seen. These areas are close to Wabiskaw river and the timber could be easily floated down that stream to Peace river. The tops of Buffalo Head hills are covered with poplar, spruce, birch, and jack pine, partly fire killed.

The soil of the district consists generally of black loam with clay or sandy clay subsoil, and is very suitable for mixed farming.

Good hay land is found in tp. 104-14-5 and numerous hay marshes and meadows of different sizes were also noticed in several other townships, principally tp. 108-17-5, the northern part of tp. 108-16-5, and tp. 108-11-5. Fresh surface water is found in different lakes and marshes as well as in the creeks and rivers, but in the rivers, especially in Peace river, the water is generally muddy in summer. Alkaline water is also found in different lakes and sloughs.

Besides Peace river the largest streams noticed were Wabiskaw, Mikkwa, and Boyer rivers. All these streams are tributaries of Peace river; they rise very high with the summer rains. The sides of the valleys, though steep, are broken by numerous ravines which afford easy slopes to the river flats.

Peace river varies in width from one-half to one and one-half miles, with a depth of about thirty feet and a current averaging two and one-half miles an hour; it still affords the easiest and most direct route to reach Fort Vermilion district. Settlers starting from Edmonton can travel via the Edmonton Dunvegan and British Columbia railway to Peace river Crossing and from there may board any of the numerous

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steam or gasoline boats which are now plying from the Crossing to all points between Hudson Hope and Vermilion chutes, or if preferred they can build rafts or scows upon which to load their implements, furniture and supplies and float down the stream to their destination. Fort Vermilion can be reached in this way in about a week. The river is usually open by May 1.

Good wagon roads lead from Fort Vermilion or North Vermilion to all the townships surveyed which are not reached directly by the river. I am informed that the Alberta Government intends to continue the opening of the wagon road from North Vermilion to Peace River Crossing, which is already cut as far as Keg river.

During the two summers spent in that country, I observed that the climate was very dry and warm, though the nights were cool, but no frost was noticed between June 15 and September 1. One occurred on June 15, 1915.

The intervening winter was cold, which is characteristic of that high latitude, but the atmosphere is so dry that the party did not lose one complete day's work on account of cold or stormy weather.

The average depth of the snow for that winter did not exceed twenty-four inches, which however is considered more than usual; it was all gone by April 15. Seeding was started about May 1, and the crops were ripe and harvested in good condition by the end of August.

Trapping is still the main occupation of the settlers, and is the principal trade of the country, though the farming business has been gradually increasing every year until the European war put a stop to immigration. At the close of the war however, the Fort Vermilion district is bound to boom owing to the quality of the land and the advantage it offers to intending settlers, who would find a local market for their produce, as it is one of the most northerly points where supplies may be procured by travellers, trappers, and Indians, inhabiting the northern wilderness.

In view of the future development of the country, many boats are now in readiness for service on Peace river, and a new company has also decided to increase that service by adding a large boat, which was under construction at Peace River Crossing when I left last fall, so the prospects are that a more frequent and regular service will be inaugurated on that river.

With the exception of Vermilion chutes, where immense power could be developed, no water-power sites were noticed. No minerals, coal, or stone-quarries were seen except deposits of limestone at the mouth of Mikkwa river in tp. 108-5-5. At Vermilion chutes, a company has started boring for oil, and when they temporarily stopped drilling last fall at the depth of 280 feet they claimed the prospects of success were very good.

A few oil claims have also been staked by other companies in the neighbourhood of the chutes, and if their expectations are realized, the intention is to build a railway at once from Athabaska via Wabiskaw lake to Fort Vermilion. Preliminary surveys have already been made with that end in view. Large game and fur-bearing animals are still plentiful in Buffalo Head hills, but scarce near the settlement. Usually the hunters have to go a long distance for their trapping.

A Board of Trade has been organized at Fort Vermilion, composed of the most influential residents of the community, with the object of aiding in the development of the district.

Protestant and Roman Catholic schools and churches are located at Fort Vermilion and at Stony Point, which is about seven miles from the former place.

Judging from the climatic conditions in Fort Vermilion district, as I observed them, and from information I gathered from pioneer settlers, I venture to say that outside of the immediate vicinity of the river valley safe crops of all kinds of cereals cannot yearly be expected until the country is entirely opened and cultivated. This would allow the heat of the sun to penetrate the ground, which now remains frozen until late in summer, on account of being mostly covered with bush and scrub. Mixed farming, however, will always be safe.

APPENDIX No. 40.

ABSTRACT OF THE REPORT OF A. LIGHTHALL, D.L.S.

SUBDIVISION SURVEYS NORTHWEST OF EDMONTON.

My instructions for the season of 1915 were to subdivide townships 61 and 62, range 8, townships 63, 64, and 65, range 7, and township 65, range 6, all west of the Fifth meridian. These townships lie in a block about one hundred miles northwest of Edmonton, and just north of Athabaska river.

After making a preliminary trip into this district, I decided that horses and wagons would be the best means of transportation. I accordingly started the wagons and horses from Edmonton a couple of days ahead of the party, which left Edmonton by rail and met the wagons at Westlock, in tp. 60-26-4, on May 25. From there the remainder of the trip was made on foot. The country is fairly well settled right up to where our survey began, but at the time we went in, the summer rains had just started and the roads were in very bad condition. However the Provincial Government had considerable work done on this road during the summer, and when we came out in the fall it was in fine condition. The settlers have been in this district four or five years and already have made great progress. It is a country suited for mixed farming rather than for grain growing, and more than enough beef, pork, butter, and eggs are produced to supply local needs.

We crossed Athabaska river on the ferry at Holmes Crossing and followed the wagon road on to Freeman River post office. From that point we had to cut our own road to the 17th base line, a distance of about fifteen miles; this work occupied five days. It is comparatively easy to make a wagon road on high land, but crossing the numerous muskegs is a slow, tedious proceeding. A thick mattress of brush is laid down to prevent the horses and wagons from sinking; this is known as a brush road as distinguished from corduroy, which is more permanent and is composed of larger timber.

The survey was started on June 7, in tp. 65-7-5, and was carried easterly into tp. 65-6-5. The old Klondike trail from Edmonton to Dawson passes through the latter township. This is a wagon road, and it is in a fairly good state of preservation. It is still used by an occasional Indian or half-breed travelling to the Lesser Slave lake region. Some very good grass land is found along Timeu creek which flows southeasterly through these two townships.

After the completion of these townships we carried our surveys southerly towards Athabaska river. Along Freeman river which flows southeasterly through tp. 63-7-5, the timber is lighter and there are some fine stretches of grass land which is very suitable for cattle raising. Township 61-8-5, the most southerly of the group, is within a short distance of Athabaska river and the land is more rolling and hilly than farther north. A lake about two miles long and half a mile wide, known locally as Goose lake occupies the northern part of this township. Although there are numerous lakes in this district, this is one of the few that has any considerable depth of water, thirty feet being found over a large part of it. Considerable quantities of jackfish are taken from it in winter and shipped to Edmonton.

The climate in general is rather moist over this section of country. A long dry spell occurs in the spring, but from June until August, rain is plentiful. In the fall the weather is usually very fine, being clear, cool, and dry, and the winter is not very severe. Summer frosts occurred last season until the first of July, but this did not

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seem to affect the growth of grain or vegetables. Potatoes which were frozen down flat on July 1, were up again and in full blossom by the middle of August, and were a splendid crop when dug in the fall. Grass is abundant and of fine quality in the summer, and cattle and horses running at large get very fat. The Indians leave their stock out all winter without any shelter and without putting up any feed for them, and although this works fairly well with their animals it is not a practice to be recommended for ordinary farm stock.

The survey was completed on November 15, and on the 23rd, we reached Edmonton where the party was discharged.

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APPENDIX No. 41.

ABSTRACT OF THE REPORT OF G. J. LONERGAN, D.L.S.

INSPECTION SURVEYS IN THE PEACE RIVER DISTRICT.

I left Ottawa on April 8, 1915, for Calgary, where I joined Mr. C. F. Miles, D.L.S., and with him proceeded to Edmonton to appraise the outfits of a number of surveyors who had been employed under contract in 1914. This was necessary as the department had decided to abandon the contract system, and had consented to purchase the outfits. As the outfits were located in different parts of the country, this necessitated much travelling, and took considerable time.

I left Edmonton on May 30 for my next work, the survey of timber berth No. 2210, near McGillivray in British Columbia. The surface of this district is extremely rough, and is thickly covered with large timber. The Riverside Lumber Co. have a saw-mill about five miles south of McGillivray, and not far from the timber berth. This was one of the few saw-mills in British Columbia that was in operation last summer, giving employment to about four hundred men. The timber on this berth is chiefly spruce and fir up to about twenty-four inches in diameter with a few pine and larch. The estimated amount of lumber is between two and a half and three million feet.

After completing this survey I returned to Edmonton, whence I left for Peace River Crossing to inspect a number of contract surveys in the Peace River district, commencing with Mr. R. V. Heathcott's survey northwest of Bear lake. The townships in this contract were at one time covered by a spruce forest, but repeated fires have destroyed the timber and burned up the windfall, and the ground is now covered by a second growth of small poplar and willow scrub. The soil is good, chiefly a clay loam, and as the land will be easily cleared, there is no doubt it will soon be taken by settlers. As the horses contracted swamp fever here, I decided that it was not prudent to continue working them, and thought if they were given a few weeks rest on high dry ground they might recover. I therefore returned to Peace River Crossing and left them in charge of one of the men.

I rented two row-boats and started down the river sixty-five miles to Mr. J. A. Buchanan's survey, which we inspected.

I then returned to Peace River Crossing and started for Spirit River to inspect Mr. Tipper's survey.

After completing the inspection of Mr. Tipper's survey we moved northwest of Vanrena to inspect the surveys of Messrs. H. S. Day and T. A. Davies. I left my assistant in charge of this work while I went to Peace River Crossing to make arrangements for the wintering of the Government horses in that vicinity. I then returned to my party and completed the inspection in that district.

There is a large tract of exceedingly good country extending from Island lake in tp. 83-4-6, westerly along the north side of Peace river to Fort St. John. It might be described as fifty per cent prairie and the remainder covered with light poplar and willow scrub. The ground is covered with a luxuriant growth of upland hay and peavine. There is an abundant supply of water in the numerous creeks and small lakes, and the soil is a loamy clay.

On the completion of this work it was decided to leave at once for the Peace River block to inspect the surveys of Messrs. S. D. Fawcett and L. Brenot. As the wagon road on the north side of the river was in very poor shape, and as the trail from Spirit River settlement was only fit for winter travel, it was decided to drive around by Saskatoon Lake and thence up the fertile valley of Beaverlodge river to

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the southeast corner of Pouce Coupe settlement. From there we followed the telegraph line to the south side of Peace river opposite Fort. St. John. There was no ferry at this point, and being advised not to attempt to swim the horses as I might be caught across the river with running ice, I hired a few horses on the opposite side of the river, and with a blanket for each man and some provisions, we started for Mr. Brenot's work, which was scattered along the north side of Peace river from Fort St. John westward.

This district is a continuation of the country west of Island lake, previously mentioned, and is reported to be ninety by forty miles in extent. It is covered by light scrub with many open places. The surface soil is sandy loam with a clay subsoil, and it appeared to me to be one of the best grazing countries I ever visited; the vetches and peavine make travelling very difficult. As is usual in a new country it was reported that the water question was a serious matter, the rivers, lakes, and creeks being the only supply, but there are very few settlers, and no person has yet attempted to dig a well. Fort St. John is a thriving village situated on the north bank of Peace river. It has steamboat connections during the summer, a telegraph office, and a semi-weekly mail service. It is reached on the north side of the river by pack-trails, and on the south side by a wagon road from Pouce Coupe settlement. This road follows high dry ground, the only difficulties being the crossing of Kiskatinaw and South Pine rivers and the steep banks on either side; both rivers can be forded during September and October.

On my return trip I inspected Mr. Fawcett's survey. It consisted of the subdivision of the country through which Kiskatinaw river flows. The country to the north was at one time an immense spruce forest, but it has been burned over and is now covered with light scrub. The soil is clay and the surface soil, which consisted chiefly of vegetable matter, has been mostly burned off. A better soil was found in the southern parts of townships 77, 78 and 79, and the scrub was somewhat larger with many open places. It was reported to me that west of these townships there is some very fertile land with large prairie openings. During the fall of 1913, when I was in the Pouce Coupe settlement, there was but one settler who had a few cattle and depended on trapping for a living. Last fall two threshing outfits moved up from Grand Prairie to do the threshing for the Pouce Coupe settlers. They estimated a harvest of 175,000 bushels of grain. This I believe is a record equal to anything in the world for a new country.

My last inspection of the season was that of Mr. J. H. Johnston's survey in tps. 82, 83, 84, 85, and 87-19-5. These townships are heavily timbered with poplar up to fourteen inches in diameter and some small scattered bunches of good milling spruce. Unfortunately the milling timber is not found in sufficient quantities to pay to build a large mill, but there are good openings for small portable mills, with a ready market for lumber at Peace River Crossing.

I next moved my camp to tp. 81-21-5 to do some miscellaneous surveys. To reach this place I followed the Grouard and Peace River trail twenty miles south from Peace River Crossing, and then west to North Heart river. I was surprised to find so few settlers on such good land. The apparent explanation is that people start out for Peace river and will look at nothing on this side of it. In tp. 81-20-5, I drove through some beautiful country. The land is easily cleared, there is plenty of water, and it is close to a railway and market, but there were no settlers.

On completion of this survey I closed operations and returned home, where I arrived on November 27.

APPENDIX No. 42.

ABSTRACT OF THE REPORT OF E. S. MARTINDALE, D.L.S.

STADIA SURVEYS IN THE LLOYDMINSTER DISTRICT.

Owing to the illness of Mr. G. W. Coltham, D.L.S., I took over his party on August 2 and continued the surveys until the end of the season.

The work upon which the party was engaged was the investigation and stadia traverse, where necessary, of all water areas in certain townships in northeastern Alberta. In isolated cases also where a corner could not be established in the original survey on account of a water area, and the body of water had since dried up we were required to mark the corner by a proper monument. Where more than two or three of these cases occurred in a locality the work of establishing the corners was left to be done later by a regularly organized party.

Magnetic observations were also taken in every township where it was possible to do so without interfering with the regular work of the survey.

On August 3 camp was moved to tp. 44-1-4 and investigations on the summer or prairie division of our instructions were continued. Twenty-two townships including township 44, range 1, townships 45 ranges 1, 2, 3, and 4, townships 46 and 47 ranges 1 to 8 inclusive and township 48 range 10, comprised the remainder of this portion of the work assigned to the party and was completed by September 15.

In this block the lakes were not numerous, being mostly shallow and in nearly every case fed only by surface water. Generally speaking they are gradually drying up and in fact most of the sloughs and small ponds noted in the original survey are already completely dry. The water in the majority of the lakes is more or less strongly alkaline.

The area investigated is but sparsely settled except in a few townships; however, as most of the land is patented it would appear that much of it is being held by speculators. The methods of mixed farming are being successfully followed and the settlers appear to be fairly prosperous. Crops this season were excellent.

Battle river, a stream from two to three chains in width, follows a very tortuous course through a narrow valley from two to three hundred feet in depth through the block and marks a sharp dividing line as to markets for the settlers, those north of the river depending on the villages and towns along the Canadian Northern railway while those to the south are served by the Grand Trunk Pacific. Fine steel bridges are maintained by the province in township 45 range 3, township 46 range 6, and township 45 range 7, but the long grades on both sides of the river make heavy haulage across the valley difficult and expensive. The river was not traversed as the scrub and brush along the banks made a survey impracticable until after freeze-up. Several of the municipalities are taking up the question of improved highways and in some townships are many miles of good graded roads. The Government rural telephones also extend over part of this block and are proving a great convenience to the settlers.

Completing the summer work we next went north, crossing the Canadian Northern railway at Mannville and commenced investigations in the autumn or wooded portion of our work. Township 53, range 8, township 54 range 7, township 55 range 8, townships 57 ranges 9 and 10 and part of township 60 range 11 were completed in the order named before closing operations for the season. Edmonton was reached on November 23 and the party paid off.

Lakes are numerous, the largest in the district being Upper and Lower Therein lakes each of which has an area of approximately six square miles. These lakes

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were shown on the old plan as joined but are now separated. The later has a depth of eighty-five feet near its westerly shore, this being the greatest depth noted during the season. These lakes have neither inlet nor outlet but it is supposed by the settlers that the latter is supplied by springs in its bottom as they state that they are never sure of the ice on this lake even in the coldest winter.

The settlers in this vicinity are mostly of French descent.

Fish are found in very few of the lakes investigated during the summer, the notable exceptions being St. Cyr lake in township 57 range 9, and Lower Mann lake in township 60 range 11 both of which are reported to be well stocked with pike and pickerel.

The weather from the beginning of August was exceptionally fine with practically no rain and plenty of sunshine to ripen the grain. A frost was noted in the bottoms on August 23, but it apparently did little damage. The first binder in operation was noted on August 18, and practically no time was lost throughout harvest or threshing on account of adverse weather conditions.

Prairie-chickens, ducks and partridges were fairly numerous while several flocks of wild geese, pelican and sandhill cranes were seen.

APPENDIX No. 43

ABSTRACT OF THE REPORT OF D. F. McEWEN, D.L.S.

SUBDIVISION SURVEYS SOUTHWEST OF LESSER SLAVE LAKE.

My work for the season of 1915 consisted of the subdivision of townships 72, ranges 15, 16, 17, and those portions of township 72, range 13, and townships 71, ranges 14, 15, 16, and 17 lying north of the northerly limit of the proposed addition to Lesser Slave Forest reserve, all west of the Fifth meridian.

I left Grouard on April 13 to make a reconnaissance trip through the district to be surveyed, to ascertain the condition of the trails. I then proceeded to Edmonton where I obtained my supplies and outfit, and returned north over the Edmonton Dunvegan and British Columbia railway, to High Prairie where the party was organized.

On May 12 we proceeded south over a very good wagon road which follows the right bank of West Prairie river for some distance, and then branches southeasterly to the E. by sec. 24, tp. 72-17-5, where our first camp was established. As this was the end of the wagon road it was decided to make it our main supply camp for the season. A considerable quantity of supplies was therefore freighted in and cached, and a pack-train was used for transportation throughout the work.

Subdivision was commenced in range 17, and from there we worked easterly to tp. 72-13-5, which was completed about the beginning of November. The party was then all paid off with the exception of those required for traversing. The traverse of Driftpile river and those portions of East and West Prairie rivers, which it had been found impracticable to do earlier, was completed on December 9. We arrived back at High Prairie on the 12th.

During the latter part of July, and throughout August and September, the work was greatly retarded by wasps, which were so numerous as to become a veritable plague. The nests were everywhere on the ground, and they not only caused annoyance and delay on the line, but made the work of the packers a very arduous and unpleasant task. The horses often became unmanageable, and, refusing to follow the trail, would scatter through the bush on the run, loosening and tearing off their packs: several packs were completely lost in stampedes. The canvas boat supplied by the Department was lost in this way, and could not be found.

The western portion of the district is drained by West Prairie river, which flows through township 71, range 16, and townships 72, ranges 16 and 17. Through the northern part of township 72 it has an irregular valley about half a mile wide, with steep banks about eighty feet high. In this valley it has cut a narrow channel from ten to twenty feet deep. It is about eighty feet wide and two or three feet deep, with a current of one mile per hour, and is broken by numerous small rapids. Owing to its confinement in this narrow channel, it rises rapidly during flood to as much as eight or nine feet above its normal level. Farther up stream the valley gradually disappears and above Carrot creek, which enters in sec. 10, tp. 72-17-5, the river narrows down to about forty feet.

East Prairie river flows through township 72, range 15, and townships 71, ranges 15 and 14. It has no well-defined valley through these townships, the land gradually rising from the river to the divide on each side. It has an average width of about 100 feet, a depth of one and one-half feet, and a current of about one mile per hour. It has cut a channel from ten to twenty feet deep, with almost perpendicular banks in

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which it is confined, causing the water to frequently rise six or eight feet after heavy rains, but no land is flooded. It is extremely crooked, and numerous portions of ancient beds are to be seen in close proximity to the present one. The land in the vicinity of this river is most easily reached over pack-trails leading from the station of Arcadia on the Edmonton Dunvegan and British Columbia railway. One leads south through tp. 72-15-5, on the east side of the river; another leads southwest from the same station crossing the river in sec. 5, tp. 73-15-5, and enters tp. 72-15-5, on the west side. Various branch trails lead from these to every part of the district. A pack-trail from Prairie River settlement to Snipe lake crosses the 19th base line about the middle of sec. 33, tp. 72-16-5.

Driftpile river flows through secs. 24, 25, and 26, tp. 72-13-5. It has a valley from one-half to one mile wide with well-defined steep banks, from 130 to 180 feet high. It has an average width of about seventy feet, a depth of about two feet, and a current of about one mile per hour. The country in this vicinity is best reached by the old Klondike wagon road which leads from Arcadia station.

Generally speaking, the above streams are bordered on each side by a strip of alder swamp or spruce muskeg, from a quarter to one and one-half miles wide, and distant one-half to one and one-half miles from the river. The soil in these muskegs is good, and as a rule they are shallow and could be easily drained.

The soil in the river valleys consists of from eight to twelve inches of black loam overlying a clay or sandy clay subsoil, and produces an abundant growth of hay and other vegetation wherever openings occur. At intervals along each of these rivers are to be found prairie openings of small extent, also lightly timbered areas, covered with willow and small poplar, which are easily cleared. This will be of great advantage to the incoming settler.

The higher land is mostly level or gently rolling, and is covered by a heavy growth of timber, principally white poplar and balm of Gilead from six to fourteen inches in diameter, together with scattered spruce from ten to twenty-four inches in diameter. Considerable birch also grows in the eastern part.

The soil is good, consisting principally of black loam from four to twelve inches deep on a clay subsoil, which together with the abundant moisture through June and July, produces a luxuriant growth of vegetation of every description. The whole district is well suited for mixed farming.

Drift coal of good quality was seen on the bars in all the rivers, but no veins were observed. No mineral or rock in place was seen. There are a few moose and bears in the district. One of the latter got into one of our caches and destroyed a considerable quantity of supplies. Signs of beaver were seen, while foxes, lynx and mink are plentiful.

APPENDIX No. 44.

ABSTRACT OF THE REPORT OF P. J. McGARRY, D.L.S.

SURVEYS IN THE NEW WESTMINSTER DISTRICT.

I left Hope with my party on April 22, 1915, and proceeded to Merritt; from there we went by construction train on the Kettle Valley railway to Coquihalla summit in sec. 13, tp. 8-23-6.

Our work in this district consisted of the survey of section lines along Kettle Valley railway in townships 8 and 9, range 22, townships 7, 8, 9, and 10, range 23, and townships 6 and 7, range 24, all west of the Sixth meridian. This branch of the Kettle Valley railway which runs southwesterly from Brodie junction to Hope crosses the Coquihalla summit at an elevation of 3,660 feet and has a maximum grade of two and one-fifth per cent. The line is about forty-five miles long and is rapidly nearing completion. When it is finally in operation this district will have excellent transportation facilities. Before the construction of the railway the district was reached by a fairly good wagon road from Merritt. This road is at the present time in very bad shape and completely destroyed at many points where it intersects the railway line, but it could with little expense be put in good condition again.

Along Coquihalla river in tps. 7 and 8-23-6, there is little or no bottom land. The banks are mostly steep and rocky, with little soil and numerous cliffs. At the southern end of Coquihalla lake the valley increases in width to about fifteen chains and continues over the Coquihalla summit to Coldwater river at the same average width. At the headwaters of Coldwater river in secs. 9, 10, 14, 15, and 16, tp. 8-23-6, there is a flat twenty chains in width. It is at the present time flooded on account of beaver dams, and the river flat from there north would not average more than ten chains in width. There are, however, some good bench lands in secs. 23, and 26, tp. 8-23-6, and secs. 11, 14, and 23, tp. 9-23-6. The soil in these areas is good and varies from a sandy loam to a light clay loam. There are some excellent grazing lands on the east side of Coldwater river near the south end of tp. 9-23-6, and also in the Murray lake district in tp. 10-23-6, but little merchantable timber is found in this district. Sections 33, 34, and 35, the only ones surveyed in township 7-23-6, are almost completely burned over. In tp. 8-23-6 there is an area surrounding Coquihalla lake and covering about five square miles on which the timber has not been destroyed by fire. It consists chiefly of balsam, spruce, and hemlock with a few areas containing some good white pine to thirty inches. In sections 23 and 26 there is also a thick growth of spruce, balsam, and hemlock. Secs. 1, 2, 11, and 12, tp. 9-23-6 are completely burned over, but the remainder of the township along Coldwater river is thickly timbered with balsam, hemlock, fir, pine, and spruce to twenty-four inches. In sections 1, 2, 11, and 12 of tp. 10-23-6, are found some small jack pine balsam and poplar.

Good drinking water and wood for domestic use may be found almost everywhere.

Although the winter was unusually mild the snow in the valley was still over a foot deep when the party arrived at the work on April 24. It was fast melting however, and in a few days had entirely disappeared. According to old residents in the district it is not unusual to have cold weather and snow up to the beginning of June, with winter setting in about the end of October. No summer frosts were noticed although they are said to be not unusual.

No water-powers suitable for development were noticed, and, although a considerable amount of prospecting has been done and some claims staked, there does not appear to be any mineral of commercial value in the district.

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In Coquihalla lake the trout are small but exceedingly numerous, and fishing is not very good in the rivers and small mountain streams. There are plenty of deer to the east of Coldwater river near the northern boundary of tp. 8-23-6. A few goats were seen but bears are very scarce.

The few settlers located in the southern part of tp. 9-23-6 consider the country better adapted for grazing than anything else. The short growing season and the likelihood of summer frosts makes it very unsuitable for agricultural pursuits.

After the completion of the work in the Hope district on July 29, we moved to Chilliwack and from there up Chilliwack river to the end of Mt. Baker wagon road, in section 34, tp. 1-29-6. This road is now being extended as far as the mouth of Slesse creek in sec. 32, tp. 1-28-6. There is a trail up the north side of the river as far as Chilliwack lake and on the south side from Slesse creek to Middle creek, and along Middle creek to the international boundary. The trail along Middle creek is very rarely used and is in many places, extremely difficult to follow.

Our work in this district consisted of the survey of lands along Chilliwack river through townships 1, ranges 27, 28, and 29 and townships 2, ranges 27 and 28. This was completed on October 15 after which the party returned to Chilliwack and was disbanded.

There are a number of small areas in tp. 1-29-6 and tp. 1-28-6, which are suitable for agricultural purposes. On the benches the soil is usually a light clay loam with clay subsoil, but in many of the river flats it is of a loose sandy or gravelly nature. In secs 1, 2 and 3, tp. 2-28-6, there is a large level bench which should make good agricultural land. In tp. 2-27-6 the flat along the river averages about twenty chains in width, and contains some patches of excellent soil particularly near the foot of the hills, but is heavily timbered. No good agricultural lands were found along Ford or Middle creeks and there is no good grazing lands anywhere in the district.

Timber is the main resource of the district, and it grows almost entirely on the south side of the river. The timber to the north, with the exception of a few odd patches, has been completely destroyed by fire. There is some excellent fir and cedar in secs. 27 and 28, tp. 1-29-6, many trees being as large as eight feet in diameter. Practically all the good timber and many areas that have no timber value have been included in timber berths. No logging operations have yet been carried on. Some shinglebolts are being cut on the area just west of the commencement of the work.

No traces of valuable minerals were found in the area examined, but mines, producing gold in paying quantities, are being worked near Slesse creek, at the international boundary.

The climate is practically the same as that prevailing throughout the lower Fraser valley. It is usually mild with an abundance of rain.

Trout abound in Chilliwack river and its tributaries and the fishing is unrivalled. During the season many fishing parties visited the district and there is little doubt that when the attractions of the locality become better known the number of such parties will greatly increase while the number of trout will correspondingly diminish. Game does not seem to be very plentiful, as only a few bears, goats, and deer were seen.

Practically all garden products can be grown in this district and fruit ripens well. The few settlers in the valley seem to be very prosperous and no doubt all the available land will soon be settled.

APPENDIX No. 45.

ABSTRACT OF THE REPORT OF R. B. McKAY, D.L.S.

OBSERVATIONS FOR LATITUDE IN MANITOBA AND SASKATCHEWAN.

The first observation for latitude was taken on the Third meridian in township 68. As this point could be most easily reached with sleighs, I left Prince Albert on March 5. Montreal lake which was crossed on the ice was reached two days later, and from there we followed an old sleigh road cut out by some surveyors. This trail ended at section 13 in township 68, and as the locality was favourable for an observation and the supply of horse feed was getting low, I decided to make the observation on the Third meridian near the northeast corner of section 12, while the teamster returned to Prince Albert for a wagon and horse feed for my return trip. On March 29 the teamster returned and as I had completed my observation, we commenced our return journey the following morning. There was then very little snow in the bush, but the muskegs and streams were still frozen, and we were able to use the sleigh until we reached the south end of Montreal lake, where we transferred our outfit to the wagon and proceeded along the summer road to Prince Albert which we reached on April 7.

The country in the vicinity of our work consists of spruce and tamarack swamps interspersed with sandy ridges timbered with jack pine, and is unsuitable for agriculture.

No further work was done by me until about the middle of June when I received instructions for further observations. I then proceeded to Selkirk, Man., and taking an assistant with me, we travelled by wagon to the NE. cor. of tp. 16-7-E. which we reached on June 24. After experiencing considerable rainy weather, the observation at this point was completed and we returned to Selkirk on July 8.

The next observation was on the 10th base line at its intersection with the west shore of lake Winnipeg. While in that locality a number of cariboo and moose were seen, also a number of wild geese and ducks.

We completed this observation on July 25, and moved by sailboat to my next objective point on the 8th base line, on the west shore of lake Winnipeg, which we reached on July 28.

After completing the observation on the 8th base, we sailed to Hole Indian reserve, where arrangements were made to have the outfit packed to the NE. cor. tp. 25-9-E. We reached the place of observation on August 11, but owing to the smoke and cloudy weather I was unable to start observing until five days later. We were then favoured with four good nights, and completed the observation, after which we returned to the reserve, and thence moved by sailboat to Hecla island, where we caught the steamer "Wolverine" and reached Selkirk on August 23.

The next observation was at the intersection of the Principal meridian with the Hudson Bay railway. To reach there we proceeded to Pas, and from there we travelled to the end of steel on the Hudson Bay railway. The Principal meridian crosses the railway a short distance westerly from mileage post 197. The country in this vicinity is rolling and timbered with small spruce, tamarack, and jack pine, the most of which has been fire-killed. The soil is clay and clay loam. Considerable prospecting has been done in the district traversed by this railway and several gold finds have been reported.

We next moved to the 16th base line, near its intersection with the Hudson Bay railway which was the next point of observation. This was completed on October 2 after which we returned to Pas. I then observed for latitude at the intersection of the 9th base line with the Second. Third and Fourth meridians respectively, completing the latter observation on November 4. As this completed my season's work, I shipped the zenith outfit to Ottawa and proceeded to my home in Vancouver, where I arrived on November 7.

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APPENDIX No. 46.

ABSTRACT OF THE REPORT OF J. H. McKNIGHT, D.L.S.

STADIA SURVEYS IN WADENA DISTRICT.

The party was organized at Prince Albert and on May 29, 1916, we reached tp. 33-12-2, where we began work.

The lakes in this district are all shallow and strongly alkaline, with the exception of Fishing lake, which contains clear fresh water and averages about twelve feet in depth. Pike and pickerel are caught in large numbers by the settlers, and by Indians from the reserve adjoining the lake to the west. On the north shore there is a summer resort and an excellent sand beach for bathing. The farmers are successfully following ranching and mixed farming and have a rural telephone system connecting with Wadena, a town on the Canadian Northern railway of about six hundred population.

Several of these small alkaline lakes could be easily drained, as the average depth is less than nine feet. Ponass lake, the largest body of water in the district, covers about seventeen square miles. The shore line is very irregular being a series of narrow points from one to three miles in length. The water is alkaline and the average depth is five feet. There are no creeks entering the lake and the outlet has been deepened and enlarged by the settlers, and at the time of survey the estimated discharge was forty cubic feet per second. This has lowered the water level nearly two feet. Abundance of excellent hay grows around the lake and on the larger islands; hundreds of tons are cut each year. The soil in this district is a good clay loam, but there is considerable bush to be cut and cleared before the land can be cultivated. The settlers are nearly all Norwegians or Galicians, who go in for mixed farming and cattle raising. Although only a newly-settled district, several of the settlers have from sixty to one hundred head of cattle.

Many of the other lakes have dried up to such an extent that large areas of the dry beds are under hay. Mixed farming is extensively followed and appears to be the industry best suited to the district.

I closed operations on November 18, and discharged the party.

APPENDIX No. 47.

ABSTRACT OF THE REPORT OF W. A. A. McMASTER, D.L.S.

RESURVEY OF PRINCE ALBERT SETTLEMENT.

We began the resurvey of Prince Albert settlement on August 25, 1915, by retracing the rear line, where we had discontinued operations the previous season. We then went to the base line, and in retracing it found only one monument within the city limits. After entering the city the base line runs along Fifteenth street to the line between river lots Nos. 70 and 71 and there it is deflected to the north. It was impossible to rerun the base line from the east side of river lot 72, so we made a traverse from this point to the east side of river lot 82.

As nearly all the monuments on the base line fell on streets or avenues, we left the base line and started to retrace the boundaries of the Hudson's Bay reserve.

On finishing this work we returned to the base line and put in iron posts where they did not fall on streets or avenues, and where they did we connected them to the street corners. This was very difficult as a great many of these corners, having been put in from thirty to forty years ago, were very hard to find.

Having completed the work in the field on October 7, I discharged the party on the following day.

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APPENDIX No. 48.

ABSTRACT OF THE REPORT OF A. M. NARRAWAY, D.L.S.

MISCELLANEOUS SURVEYS IN SOUTHERN ALBERTA AND SASKATCHEWAN.

My first work consisted of an examination of the 3rd correction line across ranges 10 and 11, west of the Fourth meridian, for duplicate monuments. This work was done before my regular party was organized.

Organization was completed at Maple Creek on April 24, and our main camp was kept there while we resurveyed tp. 11-25-3. This work was completed on May 12.

On May 17, we commenced the resurvey of tps. 13 and 14-29-3. Both of these townships are rolling prairie with numerous drifting sand-hills. On this account many monuments were missing, and permanent ones were difficult to establish. Good progress is being made by the settlers, who were helped by the heavy rains during the first week in June. Considerable horse and sheep ranching is being carried on in these townships.

We left this district on June 10, and commenced the resurvey of tp. 13-26-3, on the 11th. This township is gently rolling prairie, and contains plenty of good water and feed for ranching purposes. Maple creek, a stream about fifty feet wide and ten feet deep, passes through the township, running north from springs in Cypress hills; it contains good water.

Our next work was the retracement of the correction line along the north boundary of tp. 10-26-3, together with the closings thereon. This work was commenced on June 23 and finished on the 28th.

From there we moved to tp. 9-20-3 and commenced the resurvey of this township on July 1, finishing on the 16th. It is situated on the top of Cypress hills, and on account of its roughness is used largely for ranching purposes. There is excellent spring water throughout the township. Swift Current creek, which flows through the township, is a very crooked stream, about nine feet wide and four or five feet deep.

The retracement of tp. 13-23-3, was commenced on July 19. More than half of this township is taken up by Crane lake, which in many places is over twenty feet deep. The great sand-hills run right to the edge of the lake on the east and north, with the result that very few monuments in these districts can be found. Section 7 of this township is devoted to farming and this season some good crops were harvested. The remainder of the township is used for ranching purposes. Some large flocks of sheep, as well as cattle and horses, were seen in this district. Crane lake is noted throughout southern Saskatchewan for its game. In the fall large flocks of geese and ducks congregate on it, and hunters find it an ideal shooting place. The Canadian Pacific railway passes within one mile of the township, and shipping to the market is thus convenient.

We next proceeded to tp. 16-22-3, and commenced its retracement on August 10. This township lies partly in the great sand-hills, which is a large range of hills composed of sand, and largely covered by willow, cherry, and buckthorn brush. In places large bare sand stretches were seen, where the drifting sand had covered trees fifteen feet high. Many monuments were missing throughout this township. In the southeastern portion the settlers have made good progress, but even there the soil is light and requires a lot of moisture to produce a crop. This year, being exceptionally wet, the grain fields were good and the yields high. A large part of the township is devoted to ranching.

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Our next work was the resurvey of tps. 22 and 23-19-3. This was commenced on August 28, and completed on September 23. Both of these townships proved to be exceedingly difficult to survey. Township 22-19-3 is mostly sand-hills and is largely devoted to ranching. The southern part of tp. 23-19-3 is broken by South Saskatchewan river. A large portion of the lines in the vicinity of the river had to be cut through a dense and almost impassable bush of buckthorn. This part of the township is largely used for stock raising while the northern part is well settled and good farms were seen.

Leaving this district on September 24, we moved to tp. 12-18-3 which we resurveyed. The land in this township is nearly all patented and under crop, and seldom have I seen as good crops. The soil is very rich and there is usually plenty of moisture. Most of the settlers have very good homes and look very prosperous. I closed operations and disbanded my party on October 14.

APPENDIX No. 49.

ABSTRACT OF THE REPORT OF R. NEELANDS, D.L.S.

STADIA SURVEYS IN PRINCE ALBERT DISTRICT.

We left Prince Albert on May 22 for tp. 44-24-2 in which we closed operations the previous season. A large number of lakes and sloughs were found in the townships around Wakaw lake which were investigated. Many sloughs which existed at the time of the original survey having dried up, the section lines were produced across the dry beds and monuments erected thereon.

This district is comparatively new, and as much of the land requires to be cleared, settlement is slow. Mixed farming is the only industry for which the locality is suited. The surface is generally rolling with small bluffs of poplar and willow, and intervening stretches of prairie.

Having completed the work in the vicinity, we moved south on August 5 to the district around Humboldt, which is a good well-settled farming area. Some grain is grown, but mixed farming is the general industry. The surface is rolling, with some willow and poplar bluffs.

On September 15, we moved to Duck lake in tp. 44-2-3, and made stadia surveys in this and the surrounding townships. Along Saskatchewan river there is first-class farming land, the industry being divided between grain growing and mixed farming. Settlement here is comparatively old and most of the settlers are well established. The roads are all improved, and a branch of the Canadian Northern railway traverses the district.

The early part of the season was unusually cold and wet, and about ten days' time was lost on account of rain. The total amount of rainfall for the season, however, was below the average, and as the preceding year had been unusually dry the lakes were much below their normal low-water level, and most of the sloughs were dry by the end of August. In all five hundred and twenty-six miles of lake and river shore line were traversed and one hundred and twenty-nine miles of section line were resurveyed.

The crops in the Prince Albert district were good and the yield per acre was above the average. The crop was spoiled in a few places by rain and frost. The acreage under cultivation was increased by about eight per cent. Steady progress has been made in road building and in clearing and there is noticeable improvement from year to year, in the farming methods and in the condition of the settlers.

I closed operations for the season on October 27.

APPENDIX No. 50.

ABSTRACT OF THE REPORT OF W. H. NORRISH, D.L.S.

SURVEYS IN THE NEW WESTMINSTER DISTRICT, BRITISH COLUMBIA.

Our first work for the season was the survey of additional villa lots at Woodhaven. This subdivision is a distance of ten miles by water from Vancouver and is situated on Bedwell bay, which is part of the North arm of Burrard inlet.

We found Woodhaven to be heavily timbered with Douglas fir, hemlock and cedar. The ground was also found to be rather rough, a number of small cliffs being encountered. We were camped there from April 12 to May 17. During that time we completed the work in twelve blocks, and tied in and destroyed certain old monuments no longer required.

Our next work was to consist in establishing the north limit of the railway belt between Pitt and Harrison lakes, and as I was instructed to remain at Woodhaven only until such time as the weather was deemed favourable for work on the belt limit, I spent several days during the first week of May on an exploration trip to Pitt lake and up Osprey creek, in the direction in which the belt limit was to be produced. The post from which our work was to start was found to be on the peak of a mountain and deeply covered with snow, but the snow was melting rapidly and the weather was so favourable, that it was decided to commence work at once. Consequently on May 17, we moved from Woodhaven to Pitt lake, and established a base camp at the mouth of Osprey creek. The weather thus far had been exceedingly favourable, but a rainy spell set in, and from the 18th. to the 21st. the only work accomplished was the man-packing of supplies from the main camp to a cache five miles up Osprey creek. On May 21, we packed supplies and camp equipment to an altitude of approximately 4,200 feet above Pitt lake, and established our first fly camp near the post from which our survey was to commence.

The first mile of line was one of the most difficult encountered. In this distance we encountered two deep canyons which were only three chains apart. The second of these was about 1,000 feet deep and nearly 1,000 feet wide, and extended down the whole face of the mountain. Three camps were necessary to complete this first mile, nearly all of which was considerably above the snowline. On each move we had to man-pack the camp equipment over the highest parts of the snow-capped peaks. The weather continued to be very unfavourable, great delay being caused by the heavy fogs, which hung almost continuously on the peaks, and it was not until June 3, that we completed our first mile of line.

By the end of June we had completed five miles of the belt limit, and had established our eighth camp. During all this time supplies were being man-packed up Osprey creek from Pitt lake, and by means of side trails were taken high up on the peaks, it being our policy to maintain fly camps very close to the line, and thus avoid as far as possible tedious daily climbs to work. Up to the end of June we were able to make actual progress on an average of only one day out of three owing to weather conditions. The remainder of the time was largely used for man-packing supplies, exploring and trail cutting.

A launch had been rented for transporting supplies up Pitt river and Pitt lake to our first base camp. At the end of June this transportation route was found to be no longer feasible. Our main man-packing trail had been produced beyond the source of the east branch of Osprey creek and across the summit dividing Osprey

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and Boulder creek watersheds at an altitude of more than 5,000 feet above Pitt lake. Ahead of us lay Boulder creek in a very narrow valley, nearly 2,000 feet deep with very steep precipitous sides. An exploration showed that it was going to be extremely difficult to man-pack supplies and camp equipment across this valley. I therefore decided to leave the party with food for about two weeks and the minimum camp equipment, and to establish a base camp at or near the head of Stave lake, and from there to man-pack supplies westward toward the party, who would in the meantime produce the belt limit across Boulder creek valley.

On July 2, supplies were taken from Ruskin to Stave falls on the Stave Lake railway, a steam railroad six miles in length, owned and operated by the Western Canada Power company. On the following day a launch owned by Abernethy and Loughheed, a logging firm operating on Stave lake, moved our outfit to the head of Stave lake and a base camp was established on Clearwater creek, one and one-half miles from the lake. We immediately commenced to cut a trail westward up Clearwater creek valley, and on July 8, three men from the line party who were looking for us found their way into camp. They reported that the belt limit had been produced about two miles since I had left, being carried across Boulder creek valley and over another high summit to the east branch of Boulder creek. Camp had been moved twice during the interval, and was established at a probable distance of ten miles from the base camp on Clearwater creek. In order to get supplies in, it was necessary to pack up a very steep mountain side lying to the south of Clearwater creek and over the summit at an altitude of probably 3,500 feet above Stave lake. The line was run about two miles farther from this camp and triangulated into Clearwater creek valley, a descent of over 4,000 feet. During the period from July 8 to 21, the hardest man-packing of the season was encountered. On the latter date camp was moved down into Clearwater creek valley and established about five miles from the base camp.

The distance triangulated in producing the line into this valley was about fifty-five chains, and considerable heavy cutting was necessary to run the duplicate bases, each thirty-nine chains in length. Consequently this triangulation was not completed until July 26.

After crossing Clearwater valley the belt limit ascended a burnt-over mountain with deep canyons running down its face, and numerous cliffs reaching an altitude of 4,000 feet at the NE. cor. sec. 1, tp. 6-3-7. No water was to be found on this mountain; it was therefore impossible to follow our general procedure of camping near the line. The work was consequently very tedious on account of the high climbs to and from work over burnt fallen timber and steep cliffs. On July 29, camp was moved to the base camp near the mouth of Clearwater creek. After completing the north boundary of section 1, the line turned north along the east boundary of section 12, and almost immediately dropped over an 1,800-foot precipice requiring another triangulation. In fact triangulations on the belt limit were quite frequent, two others having in the meantime been necessary to cross canyons on the face of Burnt mountain.

On August 7, we moved from Clearwater creek via Stave lake to a deserted logging camp on upper Stave river, about three miles above the lake, and established another main camp. During high water on upper Stave river supplies could be taken within about one and one-half miles of this camp by launch, and either man-packed or hauled by wagon over a logging road the remainder of the distance.

Extensive logging operations were being carried on in this vicinity during the summer by Abernethy and Loughheed, and they maintained a bi-weekly launch service between Stave falls and their various camps on the lake, for the purpose of taking in supplies. We were able to make arrangements with them for the transport of our provisions, etc. For our own convenience in carrying on triangulation work on the lake and getting to and from Stave falls, I purchased an attachable row-boat motor for use with a large row-boat which I brought from Woodhaven.

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The belt limit after crossing Burnt mountain paralleled upper Stave river for the next mile and climbed a very rough shoulder to an altitude of about 3,500 feet, entailing some very heavy cutting, triangulation, and hard climbing, with the result that slow progress was made. It crossed upper Stave river on the E. by sec. 18, tp. 6-2-7. At this point connection was made with certain monuments established by Mr. J. E. Ross, D.L.S., in 1897. Both banks of upper Stave river were traversed through section 17. After leaving the main Stave river valley the line followed the east branch, known as Stump creek, and ran over some very steep cliffs along the base of a burnt-over mountain on the north side of the valley. The line had to be offset to get by some inaccessible points. On September 6, the line crossed Stump creek for the last time on the N. by sec. 22, tp. 6-2-7, and commenced the ascent of a very steep precipitous mountain, rising to a height of probably 5,000 feet above the valley. The northeast corner of this section was witnessed at the foot of the cliff, fifteen chains from the corner, and as the weather appeared to be unfavourable for continuing the survey of the belt limit, I decided to move to tp. 21, E.C.M. and commence some subdivision surveys.

While engaged on the survey of the belt limit, my party consisted of ten or eleven men including myself. The labourers were all engaged with the understanding that they would man-pack supplies whenever necessary. Consequently, this heavy work was shifted from man to man, with better results than if certain men had been employed for that purpose only. The size of the line party was varied from day to day according to the amount of timber to be cut, the remainder being employed on exploration, trail cutting, and man-packing. On days when on account of weather conditions it was impossible to make progress on line the whole party was often employed on man-packing.

During the months of August and September, while the party was employed on the regular work, I spent several days in making connections with a system of triangulation established on the shores of Stave lake by the Western Canada Power company, and also with the SW. cor. sec. 23, tp. 4-3-7.

The portion of the country crossed by our belt limit surveys was very mountainous, being a portion of the Coast range. The mountains are of granite formation and rise to altitudes of from five to seven thousand feet above sea-level. In general they are heavily timbered, despite the fact that they are extremely rough. Cliffs are very numerous and were encountered from 1,000 to 4,000 feet in height. Canyons up to 1,000 feet in depth were crossed by the line. The commonest timber met with was hemlock, which ran up to four feet in diameter. White and Douglas fir of similar dimensions was fairly common, while in the valleys considerable cedar up to seven feet in diameter was encountered. Heavy stands of dry cedar were found on the base of Burnt mountain and on the burnt-over mountain lying to the north of Stump creek. In upper Stave river and Clearwater creek valleys, cedar of considerably larger dimensions were seen, while small clumps of spruce up to nine feet in diameter were seen. On the peaks cypress or yellow cedar was fairly thick and ran up to about six feet in diameter.

Practically all of the timber of commercial value in the vicinity is included in the various timber berths. Messrs. Abernethy and Loughheed who are the largest operators on Stave lake are taking off about three million feet of timber per month. The logs are boomed on the lake and towed to Stave falls, where they are loaded on cars, and taken over the Stave Lake railway to Ruskin, and again dumped in Stave river, boomed and towed down Fraser river to whatever mill purchases them. This timber consists mostly of cedar and fir and also a few spruce. A large number of shingle-bolts are being cut in the valley of upper Stave river in the vicinity of the belt limit, and also along lower Stave river and Cascade creek. These shingle-bolts are also towed to Stave falls in booms, and allowed to pass over the Western Canada Power company's dam. They are then carried by Stave river to the large shingle-mill located at Ruskin. At the time we left that vicinity it was estimated that about 4,000 cords of shingle-bolts

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had been cut along upper Stave river and were ready to be floated down during high water in the fall.

Very little soil of any description was found. We did not find any first-class land, and my field notes show only small portions of second-class agricultural land in Clearwater creek and Stave river valleys. Even these portions are of little value on account of their distance from markets, the difficulties of transportation, and the amount of timber to be taken off to clear the land. In this connection it might be noted that the main reason for establishing this portion of the belt limit was not to throw open agricultural lands, but to settle certain disputes over valuable timber in the valley of upper Stave river.

Several large creeks or rivers were encountered, notably Osprey creek emptying into Pitt lake, Boulder creek flowing into Lillooet lake and Clearwater creek and upper Stave river flowing into Stave lake. These streams are all very rapid and are fed mostly by the melting snow on the peaks; consequently their flow is very uneven and is not very dependable for development of power. The valleys are very narrow and there is little chance to conserve the run-off at flood time by constructing dams. The fall per mile on these streams is very high but there are few falls. A large quantity of the power is now being developed at Stave falls by the Western Canada Power company, and is being used in Vancouver, New Westminster, most of the lower Fraser valley towns, and as far south as Sumas, Washington. This project has only been about half developed and there is still another site about two miles farther down Stave river where as much more power can be developed. In connection with this project, the level of Stave lake was considerably raised for storage purposes, and it is now intended to raise the elevation of the lake another twenty-five feet, by increasing the height of the dam at Stave falls. The valuable timber on the area to be flooded is now being removed.

The climate is comparatively mild with but little snow in the valleys, and a very heavy snowfall on the peaks. The average annual precipitation at Stave falls during the years 1910, 1911 and 1912 was 77.4 inches, but there is no doubt that it is much greater in the mountains traversed by the belt limit.

Minerals of economic value are very scarce though some traces of copper and iron are to be found. A number of claims have recently been staked near the head of Stave lake and are being prospected for iron ore.

Game is not very plentiful; a few mountain goats were seen and just one deer. No bears were seen although there were numerous evidences of their presence. Fish are fairly plentiful in Stave lake and some of the near-by creeks. They consist mostly of the common varieties of trout.

On September 8, we moved by way of Dewdney to sec. 1, tp. 18, E.C.M. During the following week we ran the west and north boundaries of sec. 6, tp. 21, E.C.M. and placed monuments for the legal subdivision corners.

On September 15, we moved to tp. 4-2-7 where we completed the subdivision of the good lands in sections 4, 8 and 9. A wagon road running up the east side of Hatzic valley connects this township with Mission and Dewdney and a new piece of road constructed this year now connects with the wagon road from Mission to Stave lake on the west side of Hatzic valley.

On September 30, we moved to Vancouver, and the following day moved by boat to Woodhaven to finish the work discontinued in the spring. Probably about half the lots fronting on Bedwell bay have now been built upon, and during the summer a number of families had resided at Woodhaven. There are at present two great hindrances to the development of this subdivision. First, a public landing place is badly needed. At present all the wharves are privately owned, and it is only through the courtesy of these owners that the passenger boats plying to and from Vancouver are able to land their passengers. Numerous other launch owners and holiday parties are greatly inconvenienced. Secondly, no roads have been built, and it will be impossible to build

cottages or houses on the lots away from the water's edge, until some roads are constructed to allow the transport of building materials.

The Harbour Shipping company operates a semi-daily boat service between points on the North arm of Burrard inlet and Vancouver during the summer, and a daily service during the winter. It takes from one to one and one-quarter hours to reach Vancouver from Woodhaven. Most of the residents are Vancouver business men, who go to the city every day. This resort is tenable during the entire year on account of the mildness of the coast climate, though at present it is popular as a summer resort.

On October 15, we moved to Vancouver where the party was disbanded for the season.

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APPENDIX No. 51.

ABSTRACT OF THE REPORT OF P. E. PALMER, D.L.S.

STADIA SURVEYS IN SOUTHERN SASKATCHEWAN.

I organized my party at Regina, and on May 31, 1915, proceeded to Findlater in tp. 21-25-2 where the season's work was begun.

This work consisted of the investigation and survey of water areas in a block comprising townships 21 to 33, inclusive, range 25, west of the Second meridian to range 1, west of the Third meridian, inclusive. This kept us employed until October 22, when the party was disbanded.

The part of my work lying south of township 28 was in a thickly-settled country where but few stadia surveys were required. As a rule the amount of work done each day by the party in this district was only limited by the endurance of the horses. Under favourable circumstances a township could be thoroughly examined in a day. This section of the country is well provided with railways, and from an agricultural standpoint is one of the finest parts of Saskatchewan. Grain growing is the staple industry, and the towns and villages are merely supply and shipping points for the surrounding country. Probably the finest country included in my work was around Davidson, Craik, and Girvin, on the Regina-Saskatoon branch of the Canadian Northern railway. The excellent roads and well-built farmhouses and barns were conclusive evidence of the prosperity of the country. The districts around Eyebrow, Simpson, Imperial, Liberty, and Holdfast also show evidences of prosperity. Phenomenal crops of grain were harvested in all these localities in 1915.

Much of the country around Young is also excellent, but unfortunately much of the grain in that district was damaged by hail last season. However, owing to the excellent system of municipal hail insurance, conducted by the Saskatchewan Government, the individual losses to the farmers were slight.

A section of rough hilly country extends in a northwesterly direction from tp. 28-26-2 to tp. 31-1-3. This district is for the most part sparsely settled and has few roads or trails. It is not very suitable for agriculture, as much of the land is too rough and stony to be broken. It is however fine range country, though there are not many cattle on it at present on account of most of the land being homesteaded. Good roads are urgently needed for the development of this section. There are numerous small lakes through these hills, and consequently I was obliged to make a very close examination of this whole district. This work, on account of the absence of trails, was necessarily slow.

Manito lake was the only important body of water included in my season's work. This body of water, which is about thirteen miles long, lies in townships 32, ranges 24, 25, and 26. It is famous for the medicinal properties of its water, which contains various salts in solution, and has a very high specific gravity, so much so that the human body will not sink in it. This water is considered beneficial to persons suffering from rheumatism, sciatica, and various skin diseases. A large sanitarium was opened on the lake shore last summer, and many cottages are built at different points along the lake.

In secs. 33 and 34, tp. 30-28-2, are five small lakes whose waters are poisonous. They are strongly impregnated with alkali, and in some places have a reddish rusty colour. This alkali forms a slight crust over the surface of the water, and even on a windy day this crust remains intact, so that not a ripple disturbs it. These lakes do

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not freeze in the winter, but the snow drifting in forms a sort of slush that will not bear the weight of a man. Several carcasses of cattle found lying in this vicinity testify to the deadly nature of the water. It is carefully avoided by the settlers of the neighbourhood.

Game such as prairie-chickens, ducks, and wild turkeys, was fairly abundant throughout this section of the country. The antelope however have entirely disappeared, the last having been seen three years ago.

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APPENDIX No. 52.

ABSTRACT OF THE REPORT OF H. E. PEARSON, D.L.S.

SUBDIVISION SURVEYS NORTH OF ATHABASKA.

My work for the season of 1915 consisted of the subdivision of townships 70 and 72, range 20, townships 72 and 73, range 21, township 73, range 22, and the southerly two-thirds of townships 73, ranges 23, 24, and 25, all west of the Fourth meridian.

The only means of access to the western part of this district is by the Athabaska-Slave lake trail as far as Moose portage, thence by wagon road to Fawcett lake and then along the pack-trail leading to Calling lake. This trail is fairly good except where it crosses two or three soft swamps. The eastern part of the district is accessible in summer by wagon trail from Calling river, but for most of the season this trail is fit only for pack-horses. The easiest way to reach the district is by winter trail from Athabaska.

A number of fine lakes throughout this district such as Fawcett, Fife, Otter, and Calling lakes, teem with fish, and during the summer months are the homes of myriads of wild fowl. Calling lake is the scene of extensive fishing operations during the winter months, and many carloads of whitefish and pickerel taken from this lake have been shipped from Athabaska. To the few settlers who have made their homes on the east side of the lake, fishing is a never-failing industry.

The most urgent requirements of this whole district, in common with much of the north country, is drainage and trails. The soil for the greater part is a splendid loam suitable for growing the best of crops, but areas of swamp are found scattered throughout the whole district, and these act like a refrigerator on the surrounding atmosphere as they hold the frost until August, and many of them never thaw out. They are to some extent the cause of the late spring and early fall frosts, and while these are still prevalent grain cannot be grown successfully.

From my personal observation I would say that every one of these muskegs has an outlet, either at its edge or within a very short distance, which provides ample fall for drainage and only requires to be properly opened up. The difficulty and expense of successfully draining swamp lands is usually owing to the trouble of getting a sufficient outlet, but in this district the problem is simple from an engineering point of view.

Trails are needed badly, even more than railroads, but it is useless trying to build them until the land is drained.

The only industries suitable for this district at present are fishing, mixed farming and possibly enough lumbering to supply local demands.

APPENDIX No. 53.

ABSTRACT OF THE REPORT OF J. W. PIERCE, D.L.S.

SUBDIVISION SURVEYS NORTH OF MCMURRAY, ALBERTA.

My work consisted of the subdivision of lands along Athabaska river from township 97 to township 101 inclusive.

I left Edmonton with my party on May 21, 1915, and proceeded by train to Athabaska, where my assistant who had preceded me had arranged for scows and scow crews to take us down the river. We left there on May 22, and arrived at the head of Grand rapids on the 26th. At this point we were delayed for some time as there were several fleets of scows ahead of us using the portage facilities. At that time the Hudson's Bay company had on Grand Rapids island a small tramway equipped with push cars for transporting goods to the foot of the unnavigable part of the rapids. During the following summer however this equipment was moved north for use on the portage between Smith Landing and Fort Smith, on Slave river. I understand that the Hudson's Bay company have abandoned the Athabaska river route as a means of reaching their northern posts. They now ship their goods by train to Peace River Crossing and from there use Peace river as their main water route.

We left Grand rapids on May 28, and reached McMurray the next day. As there were no obstacles to navigation to be encountered below this point the services of the scow crews were dispensed with and the remainder of the trip was made without assistance.

Our survey work was confined to the district immediately adjacent to Athabaska river, and as it was thought probable that two-thirds of the work could be performed from camps situated on the river banks, it was not considered advisable to go to the expense of procuring pack-horses, with the incident cost of taking them to and from the work over trails which, in this district, are few and indirect, and of procuring feed for them. It was therefore decided to equip all the members of the party with pack-straps and pack-sheets, so that when it was necessary to take our camp outfit inland, all the party could act as pack-men. With this in view, silk tents, reflectors, and bake-kettles, on account of their portability, formed a part of our outfit, and were used to great advantage. For transportation along the river, three canvas canoes and a two-horsepower gasoline engine were satisfactorily used.

Survey work was commenced on June 2, and between that date and November 15, a total of five hundred and eight miles of line were cut, and seven hundred and twenty mounds erected. The season proved to be particularly suitable for surveying, only two days being lost from bad weather. There was, however, a loss of two and one-half days in the latter part of June, due to our party assisting the fire rangers in putting out a forest fire.

On November 16, the ice on the river being sufficiently firm for our needs, a traverse of the shores of Athabaska river and of the included islands was commenced. This work kept us busy until December 2.

We then loaded our outfit behind two freight teams previously engaged in McMurray and started for Edmonton. The route followed was on the ice of Athabaska river to McMurray, then by a winter road to Gregoire lake, and thence on the completed grade of the Alberta and Great Waterways railway until we met construction trains which took us to Lac la Biche. From there we took the regular train to Edmonton where we arrived on December 16. The party was disbanded the following day.

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The most important town in the Athabaska district is McMurray, which is situated at the junction of Clearwater and Athabaska rivers. It is the terminus of the Alberta and Great Waterways railway, now under construction, and over which it is expected trains will be in operation by June 1916, as well as being at the base of up-stream navigation on the Athabaska. It is connected with the outside world by Government telegraph service and regular mails, and has a local telephone system, several well-stocked stores, good hotel accommodation, schools and churches. While it has suffered from the evils of an early real-estate boom, due to the prominence given to the oil and natural gas prospects of the adjacent country, it still presents a healthy thriving appearance. It is located in the centre of the extensive asphalt and tar deposits of northern Alberta. As yet no use has been made of these owing to their inaccessibility to markets, but it is hoped that this will be overcome by the operation of the railroad next year.

The Geological Survey have had parties engaged during the past few seasons in determining the location and extent of these deposits. I understand that some small shipments of this material, which have been tested in the pavements in Edmonton, have turned out satisfactory.

That part of Athabaska river crossing our work has an average width of about half a mile, and a current of about three miles per hour. Its banks vary from forty to seventy-five feet in height, and are usually close to the water's edge. An exception to this was noted in township 100, where a V-shaped flat, covering nine or ten square miles, occurs on the east side of the river. Through this flat Firebag river, a very sluggish, crooked stream about three chains wide, and several other smaller streams, empty into the Athabaska. Athabaska river contains numerous long, narrow islands; the largest of these are well timbered with cottonwood, poplar, and spruce, while the smaller ones are covered with willow only. About the beginning of July the river is subject to an abrupt rise from six to ten feet, due to the freshets from the mountains, and during this period many of the islands and adjoining flats are flooded. The water itself, which is naturally clear and fresh, assumes a dark muddy appearance and is barely fit for use. After about a month the water becomes clearer, and the river gradually subsides, until before the freeze-up, instead of presenting one broad sheet of water, it has given place to numerous narrow channels separated by islands and sandbars often half a mile long. Usually in low water, only one of these channels is navigable, and as this channel is constantly changing its position, due to the scouring action of the river, and to the sand deposited by the current, it follows that the navigation of this river will always present difficulties to even the most experienced pilots.

Several steamboats, the principal ones being owned by the Hudson's Bay company and the Northern Trading company, make more or less regular trips between McMurray and Chipewyan on lake Athabaska, from which point there is navigable water in all directions. In addition to these, there are numerous smaller steamboats and gasolene launches always ready to pick up custom.

The whole of the district surveyed by us this season is timbered with a healthy growth of spruce, poplar, jack pine, and tamarack, with occasional birch and balsam, the most valuable of which is found in the river valley and adjacent flats, and along the valleys of the tributary streams. Sound spruce, poplar, and tamarack up to thirty inches in diameter are to be found, and while the quantity is not great, it is of value on account of its accessibility to the river. In the southern part of tp. 97-10-5, near the base line, and across the southeast corner of tp. 97-9-5, are two high, rolling ridges each well timbered with spruce, jack pine, poplar, tamarack, and birch, up to twenty-five inches in diameter. Between these two ridges lies a very large muskeg and floating bog which drains into the most important lake in the district. This lake is situated in the southeast corner of tp. 98-9-5. It is probably five miles long by three across and empties through a small creek from its northeast corner into Muskeg river to

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the east of our work. It is surrounded by low flat country, and is itself very shallow.

The area to the east of the Athabaska, with the exception of a narrow fringe along the banks of the river, is practically all sand plains and ridges interspersed with muskegs. The timber in the muskegs consists of spruce and tamarack, some of which reaches ten inches in diameter, while on the sand, the only timber is jack pine up to twelve inches in diameter. Unfortunately the greater portion of this sandy area has been burned over, and is now growing up with second-growth jack pine.

To the west of the river and outside of our work lies a range of high hills called Birch mountain. Through the western part of townships 98, 99, and 100, range 10, there is a large willow flat, the soil of which is of first quality. This appears to extend some distance westerly, but much of it has been flooded by the action of beavers. Between this flat and the river, the country is level or slightly rolling and is composed of muskegs and sand plains with occasional rolling country. Some of the sand plains have been burned over, but where they have escaped, they are covered with jack pine up to twenty inches in diameter. The rolling country is covered with mixed timber, of which spruce and jack pine up to twenty inches in diameter is the most important. Several small lakes appear in this district.

While much of the timber in this country is not now and possibly never will attain to the dimensions of what is now considered merchantable timber, it is suitable for pulp and box wood, the demand for which is constantly increasing. The district is zealously guarded from fire by a staff of Dominion fire rangers who patrol the district regularly, and are under the direction of a chief with headquarters at McMurray.

The soil on the plains is mostly sand, and is valueless for agricultural purposes. In the muskegs, it is of first quality and easily cleared, but extensive drainage operations would have to be undertaken before it could be utilized. On the uplands, where the timber is spruce and poplar, the soil is a light sandy clay covered by a few inches of decayed vegetable matter. This, while gravelly in places, would, if cleared, yield light crops. With the exception of the first-class soil in the large willow flat occupying the western part of townships 98, 99, and 100, range 10, previously referred to, the only good soil is found in the heavily-timbered flats of the river valley, the largest of which is on the east side of the river through township 100, range 9, and extending inland up the valley of Firebag river.

Hot days and cool nights with occasional frosts were prevalent through the summer months. On June 5, 6, and 7 there was sufficient frost to form a quarter of an inch of ice on water left in pails over night. The days are very long, there being scarcely any darkness during midsummer, so that vegetable growth is very rapid. At McMurray and McKay I saw potatoes, cabbage, onions, and all the other usual garden produce fully matured without injury from frost. Permanent ice first started to form on the river on the night of October 19, the bay and shallow water being frozen first, and the main channels remaining open; these gradually narrowed up and except in a few places, the river was entirely frozen by December 1. Inland lakes were all frozen over on November 1. The lowest temperature noted occurred on our return trip to Edmonton during the first part of December, when the thermometer reached eighteen degrees below zero.

A very important feature along Athabaska river is the presence of the tar and asphalt deposits, outcrops of which were noticed along the banks all through the work. The mounds occasionally encountered this asphalt when digging pits, so that apparently considerable of the underlying strata is of this formation. In two or three places at the foot of asphalt banks, small pools of what looked to be pure liquid tar had been formed, where it was possible to dip up a cupful at a time. No indications of the presence of other minerals of economic value were noticed.

All the usual fur-bearing animals and feathered game, common to northern Alberta, are found in this district, but it is specially noted as a good fox country. Red

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and cross foxes and the various species of wolves are very common, while the presence of the rarer black and silver foxes was noticed. Beavers, mink, martens, and ermines are very numerous on all the streams and ponds back from the river. Moose, caribou, and bears were frequently seen.

Through the autumn months jackfish are very plentiful in the river, and the Indians have nets set in nearly every eddy along the bank in order to secure fish both for themselves and for their dogs. Each family puts up several thousand pounds of these fish, which are valued among themselves, at from eight to twelve cents a piece.

APPENDIX No. 54.

ABSTRACT OF THE REPORT OF T. H. PLUNKETT, D.L.S.

BASE LINE SURVEYS BETWEEN LAKES WINNIPEG AND WINNIPEGOSIS.

Our survey party left Winnipegosis on August 25, 1915, with sufficient supplies to survey the western portion of the 11th and 12th base lines between lakes Winnipeg and Winnipegosis, supplies for running the eastern half having been previously cached at Grand Rapids.

Landing half our supplies and all the party but five, at the 11th base line, with instructions to man-pack the outfit to the commencement of the work about two miles inland, I with the five men and the remaining half of the supplies sailed north to the 12th base line which had been discontinued in 1913 on the eastern shore of the lake. The remainder of our supplies were cached at this point.

We then rejoined the main party at the 11th base, and on September 1 work was commenced at the NE. cor. tp. 40-16-Pr.

This work was continued until October 11, when the line had been carried to the northeast corner of section 34, in range 13. Our means of transportation consisted of a combination of canoeing and man-packing. It was therefore imperative that a return to the 12th base be made before freeze-up, as our provisions were nearly exhausted, and much time would be lost in moving back if the ice had formed on the lakes crossed by the survey. We accordingly started back on October 11, following a splendid canoe route which we had explored during the season.

Work was commenced on the 12th base at the NE. cor. sec. 33, tp. 44-16-Pr. on October 19. Although the weather conditions at this time indicated an early freeze-up, the lakes remained open very late. The weather moderated about the end of October, and it was November 10 before the small lakes froze over, and the 25th before the ice was sufficiently firm to make travelling on the lakes safe. By November 13, sufficient snow had fallen to enable us to use dogs, and the men were thankful to be able to lay aside the pack-strap and tump-line.

By December 23 the 12th base had been completed to lake Winnipeg, and the block outline along the east boundaries of townships 45 and 46, range 13, had been surveyed to the 12th correction line. Camp was then moved to the 13th base line in range 13, and the survey of the east outline of this range southerly was commenced on December 28. A closing was made on the 12th correction line on January 7.

The weather until December 23 had remained mostly fair and moderate, affording ideal conditions for winter surveys. On December 24, however, winter assumed a different aspect; the weather became decidedly colder, and an almost continuous high west or northwest wind, with the temperature from 40 to 58 degrees below zero, made January anything but a pleasant month in this district. From December 24 until February 12, the cold was intense. During this period several tons of provisions and dog feed had to be moved south along lake Winnipeg and across Long point to the 12th base. The continuous winds filled up our trails every day, making work for the men and dogs very trying, and interfering materially with our progress.

On January 11 work was commenced at the northeast corner of township 44, range 11, and the block outline was surveyed south to the 11th correction line by January 31. A move was then made to the 11th base in range 12, where it had been discontinued in October. This point was reached on February 2.

Every effort was made to carry this base line to lake Winnipeg, but on February 13 the weather became milder, and for three days the thermometer registered 60 degrees

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above zero. Much of our trail had to be recut, owing to the stumps and logs being laid bare by the melting snow. It had been expected that our stock of provisions would barely carry our survey to the lake, but this delay made it plain that unless we were to take great risks regarding the provisions necessary to reach Gypsumville, we must give up the idea of completing the base line. It was therefore decided to discontinue the survey at the east boundary of range 10. A start was made for Gypsumville on February 22.

The west shore of lake Winnipeg was followed south to the mouth of Warpath river. Much the shorter way to reach Gypsumville would have been to follow this river to the 9th correction line and then strike across country to Gypsumville, but Indians at Grand Rapids, who professed to have trapped on the Warpath, assured us that there was a beaten trail along the river throughout its length. After ascending the river for seven miles, however, the trail stopped, and from the end of this trail, for a distance of about forty miles by river, a new trail had to be broken on snow about three feet deep. Gypsumville was reached on the evening of March 2, and Winnipeg on the 4th.

The country covered by my surveys is by far the best, from an agricultural view point, that I have seen in northern Manitoba. On the 11th base in ranges 15, 14 and 13, the country is generally high and dry and fit for agriculture. In townships 39, 40, 41, and 42, in these ranges, large areas of good land were found, wooded with poplar and willow, and with sufficient open grass land to enable settlers to make an easy start at cultivation. The grass appeared to be of the better and more nutritious varieties, and quite superior to that found south on the 10th base. The whole country would be classed as bush, but clearing operations would meet with no special difficulties, as in most places the bush is very light and could be easily cleared.

This country is dotted with lakes. Pickerel and Sisib lakes, in townships 41 and 42, and Chitek lake immediately south of the base are fairly large. The two former have fine high gravel beaches, and in them pickerel and pike are plentiful. Chitek lake is inclined to be marshy around the shores.

The soil, in most places, is black loam on a clay subsoil, and the stratified limestone which underlies this whole country seems to be five or six feet below the surface.

Easterly from the middle of range 13, the country north and south of the base gradually becomes poorer; jack pine trees predominate, and the moss muskeg and bog, characteristic of northern Manitoba, is very much in evidence. The lakes, too, disappear and water-courses are seldom found. The base line here passes through almost continuous brush and dense small jack pine and spruce, but both north and south large areas of bog are found. The soil on the low land is the usual black muck, and on the ridges is gravelly or stony clay.

The country along the 13th base, in ranges 16, 15, and 14, and the westerly half of range 13, resembled that along the 11th base in the same ranges, and many areas fit for agriculture are to be found, but the country north of this line is not quite so favourable for farming as that through which the 11th base passes.

This too, is a lake country; Kawinaw, Katimik and Kanusk are large lakes. Katimik is a very fine lake with gravel beaches and bottom, and contains clear water. Surrounding Katimik, and portions of Kawinaw and Kanusk lakes, very fine spruce sufficient for settlers' requirements is found. Nets were set in these lakes but no fish were caught.

East of range 13, and north of the line, the lakes disappear, and moss muskegs prevail. The spruce on this moss-covered country has a much more healthy appearance than that usually found on such land, and has grown larger, occasional trees attaining a diameter of from twelve to sixteen inches. Along the base and south of it in ranges 12 and 11, jack pine is the prevailing variety of timber, with some patches of good spruce and poplar.

Along the east outline of range 11 in the south half of township 44, and in townships 43 and 42, a particularly good belt of timber extends almost due north and south. It consists of spruce up to twenty-four inches, poplar to eighteen inches, and jack

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pine to fourteen inches in diameter, and of sufficient quantity to supply all local requirements for building or fencing material.

Speaking of this country as a whole, the portion suitable for settlement, in its present condition, lies along lake Winnipegosis, northerly from the 10th correction line, and includes all land within twenty miles of the lake.

Large game, such as moose, cariboo, and bears appear to be more plentiful there than in any part of northern Manitoba. Wolves, foxes, and lynx are also very numerous.

Fish are found in most of the smaller lakes and lakes Winnipeg and Winnipegosis are well-known fish producers. Mink, otters, and fishers are plentiful, and south of the 12th base little trapping is done by the Indians. Ducks abound on the inland lakes, but grouse, which a few years ago were numerous, have almost entirely disappeared. Rabbits too are not so plentiful as in former years.

The winter of 1915-1916 was a particularly severe one, not so much on account of extremely low temperatures, as on account of the almost continuous north and west winds. The snowfall was much heavier than usual, making travel through the country difficult.

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APPENDIX No. 55.

ABSTRACT OF THE REPORT OF R. C. PURSER, D.L.S.

MISCELLANEOUS SURVEYS IN SASKATCHEWAN AND ALBERTA.

The surveys on which I was engaged last season were mostly small and of a varied nature, consisting of retracements for the purpose of correcting errors in old surveys, the establishment of section and quarter-section corners in places formerly covered by water but now dry, and the traverse of water areas. On this work I was accompanied by an assistant only, and procured labourers locally when they were required.

Work was commenced near Biggar, Sask., where small surveys were required in four different townships, and from there we moved to tps. 52 and 53-1-4, where a number of duplicate monuments were removed. Some of our lines in the latter township crossed Saskatchewan river, and we were fortunate in finishing this work just before the heavy floods which caused so much damage in Edmonton.

During the first three weeks of July we made a number of small correction and retracement surveys in central Alberta. The weather at that time was very wet, and the trails and roads became very bad, particularly where the soil was mostly clay. The continued rains however were good for the crops which were exceptionally large.

We next moved to the vicinity of Edmonton where several small surveys were required. One was in tp. 53-4-5 near the village of Wabamun on Wabamun lake. This village, as well as others situated on this lake, is used as a summer resort by the people of Edmonton, and is becoming very popular. It is about forty-five miles west of Edmonton, on the main line of the Grand Trunk Pacific, and affords excellent opportunities for boating, bathing and fishing. It is a favourite resort for picnic and excursion parties.

During the latter part of August and the first part of September two weeks were spent in tp. 57-5-4, where some errors in the original survey had to be corrected before certain road surveys, made by the Provincial Government, could be registered. This township lies north of Saskatchewan river and is about sixty miles from Vermilion, Alberta, a town on the Canadian Northern railway. Ferguson Flats post office and general store is in section 35; north and east of this there is very little settlement. The settlers have been only a short time in the district, but they are very enterprising, as is evidenced by the fact that there is a large regular service for shipping cream to Edmonton via Vermilion. Stock raising is the principal occupation, the long haul to town making grain growing, except for stock purposes, unprofitable.

After finishing this work we again moved to the central part of Alberta. In tp. 31-21-4, while engaged in running lines across Red Deer river, we met a party of Dominion Government geologists who were engaged in a systematic search for palæontological specimens for the Victoria museum at Ottawa. The valley of Red Deer river is about 300 feet deep and about two miles wide. The slopes are mostly bare, being too steep to be covered with vegetation, and there are many cut banks and ravines. This valley is rich in fossil remains, and affords excellent ground over which to work.

As it had been decided to close operations at the end of October, the remainder of our time was spent in finishing up all work of an urgent nature. One of these last surveys was a lake traverse in tp. 61-27-4, near the village of Westlock on the Edmonton Dunvegan and British Columbia railway.

On October 30 we closed our field work for the season and left Saskatoon for the east. In all about thirty different surveys were made, varying in length from a few days to three weeks.

In addition to our regular surveys, observations for magnetic dip and total force were taken whenever convenient.

APPENDIX No. 56.

ABSTRACT OF THE REPORT OF C. RINFRET, D.L.S.

STADIA SURVEYS IN THE REGINA DISTRICT.

My work consisted in the investigation of water areas in the district southeast, south, and southwest from Regina, comprising the block of townships 11 to 16, ranges 10 to 24, west of the Second meridian.

Since the district was surveyed in the early eighties, most of the sloughs and small lakes have dried up and are generally under cultivation or yielding hay. In a few townships even the wells are dry this season, and some farmers find it convenient to have their water supply brought in by the railways. Others haul it from public wells sunk here and there by the Provincial Government.

In this district there are many railway lines and the roads are graded. It has been settled for a long while and is mostly all under cultivation, being level and having a clay loam soil.

Some of the land is still in the hands of speculators, but is rapidly being bought by the neighbouring farmers who seem able to handle without trouble two or more sections with the help of modern machinery.

Some lakes were found in townships 12, 13, 14 and 15, range 10, and in townships 14, ranges 11 and 12; they have changed since first surveyed, but have still potable water, found very convenient by the surrounding settlers who, besides farming, raise some cattle.

Along Chapleau lake in township 14, range 12, a beaver colony was found.

Townships 15 and 16, range 10 were the only ones in which bush consisting of poplar up to six inches and willow, was found. They are sparsely settled although the land is all patented. The soil is good, and abundant water of good quality is found.

The southwest part of the block investigated is situated in the Dirt hills where, owing to the mountainous nature of the country and the numerous fresh-water lakes ranching only is successfully carried on.

Besides the district above mentioned three townships were investigated, township 9, range 23 and township 13, range 4, which are well settled by prosperous farmers, and township 3, range 19, which although nearly vacant is a splendid ranching area, being hilly and supplied with good water.

Besides investigating water areas, eighty-five section corners falling in dried-up beds of lakes were re-established.

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APPENDIX No. 57.

ABSTRACT OF THE REPORT OF O. B. ROBERTS, D.L.S.

STADIA SURVEYS IN SOUNDING CREEK DISTRICT.

The area covered by my stadia surveys extends from Red Deer river to township 34, west of the Fourth meridian. Work was begun on May 28, in tp. 27-1-4.

Our work was greatly retarded during the first month in the field owing to excessive rains, as during the month of June we had twenty-seven days of rain. Although this wet weather was not very favourable for surveying operations it was however extremely beneficial to the farmers in the district where drought had greatly impoverished the country for the preceding few years. The district in the vicinity of the Fourth meridian is very rolling and contains much land useless for agricultural purposes. The lower land in the numerous valleys consists of good farming lands however, and is extensively worked. Although this district is comparatively newly settled it is in a very prosperous condition and under reasonable weather conditions would be one of the best farming districts in central Alberta.

On July 12, I began to move northerly leaving the traverse of Red Deer river until sometime later, and worked northerly as far as township 33.

On August 28, I began to move southerly again, arriving at Red Deer river on the 21st. I traversed the river through townships 22, ranges 2 and 3, and townships 23, ranges 3, 4, 7, and 8 and then moved northerly again in order to do certain surveys in townships for which special instructions had been given me.

Through the first eight ranges west of the Fourth meridian the country bordering on the north bank of Red Deer river for a depth of two townships is not suitable for farming purposes, but is admirable for stock-raising or ranching. In the valley of the river a scheme for irrigation was in course of construction.

The country travelled over throughout my entire district with the exception of those townships bordering on Red Deer river is of a similar nature. The surface is mostly rolling prairie with here and there some sections of hilly prairie. The district throughout is fairly well settled, and farming, the principal industry, is successfully carried on. The chief cereals grown are wheat, oats and flax. Immense crops were harvested throughout the entire district this year. Wheat yielded as high as sixty-four bushels to the acre, oats as high as one hundred and ten bushels, and flax as high as thirty-five. Under ordinary weather conditions and with good farming this locality is second to none for farming purposes. Twenty-five per cent of the roads are graded and the trails are invariably good.

After storing my outfit I left Alsask on November 2 for tp. 40-22-4. Mirror is a small town in this township with a population of about three hundred people. It is a divisional point on the railway and on account of its proximity to Buffalo lake is intended for a summer resort.

The land in this township is not suitable for farming purposes as the greater portion is either water or low lands. Some grain is grown however and cattle and horse raising is carried on extensively.

I completed work in this township, as far as conditions would permit and on November 11 closed operations for the season.

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APPENDIX No. 58.

ABSTRACT OF THE REPORT OF O. ROLFSON, D.L.S.

SUBDIVISION SURVEYS EAST OF LAKE WINNIPEGOSIS.

I left Winnipeg with my party on May 17, 1915, and travelled by train to Winnipegosis. From there we proceeded by scow and tug to the scene of our season's operations in townships 35, 36, 37, and 38, range 15, and townships 37 and 38, ranges 16 and 17, all west of the Principal meridian.

Our first camp was located on the eastern shore of lake Winnipegosis in tp. 37-17-Pr. All camp moves in this township and the one to the north of it were made by canoe on the lake. The remainder of the work was carried on from camps on Inland and Waterhen lakes, boats being used for transport throughout the survey.

Our subdivision work was completed on September 9, on which date we moved south through Waterhen river to lake Winnipegosis by canoe, and across the lake to Winnipegosis by launch. On our arrival there I disbanded the party and commenced working on my final returns.

As it had been impossible for us to do all the traversing in summer, I returned with a small party on December 9, and completed this on the ice. We arrived back in Winnipegosis on January 15, 1916.

The land in this district is clay and clay loam with occasional gravel ridges. The surface is almost all timbered with spruce, poplar, birch, and a small amount of balsam with jack pine on the ridges, all varying from six to twelve inches in diameter. For a distance of half a mile inland from the shore of lake Winnipegosis, and in a timber berth on the east side of Waterhen lake, there is spruce and poplar up to twenty inches in diameter, but with the exception of this berth, there is in no place enough timber to warrant milling. In township 35, and the northerly one-third of township 34, range 15, the country has been burned over and only small poplar now remains.

In most places the land near the lakes is dry, while farther inland it is swampy. Not having run levels over the lines, I cannot speak with certainty, but I believe it will be possible to drain all of this land. To do this properly would require a system extending over the whole district. When this is done, I am sure that the district will be suited for farming. Some parts will require no artificial drainage.

Moose and deer are very plentiful, while caribou and bears are found occasionally. The ordinary fur-bearing animals, such as mink, otters, beavers, etc., are very scarce. Whitefish, jackfish, goldeye, pickerel, and perch are found in lake Winnipegosis.

The town of Winnipegosis, which is situated near the south end of lake Winnipegosis, is the distributing point for the district. A lumber mill is located there, and a branch line of the Canadian Northern railway from Dauphin runs to the town. Many settlers are going into the district north of Winnipegosis and some are commencing to raise cattle on the land near the mouth of Waterhen river.

Fishing is still the chief industry of the district, and during the season of 1914-1915 about five million pounds of fish were shipped from Winnipegosis.

APPENDIX No. 59.

ABSTRACT OF THE REPORT OF W. A. SCOTT, D.L.S.

SUBDIVISION SURVEYS IN EASTERN MANITOBA.

I left Winnipeg where my party was organized, on May 14, and proceeded by Grand Trunk Pacific railway to Ophir station in tp. 10-17-E, and from there by canoe to tp. 13-15-E where our season's work was commenced.

After the completion of this township we subdivided all of tp. 14-15-E, tp. 13-16-E, and parts of tp. 15-15-E and tp. 13-17-E. This work was completed with the exception of the traverse work, in the latter part of October. The party was disbanded on October 28 and on January 8, 1916, another small party was organized for the traverse work which had been left to be done on the ice.

The country covered during the summer is quite rough and rocky. The elevation of the land as a whole is fairly uniform and all of it is timbered. About twenty per cent is rock of the Laurentian formation and of no value, even the timber being small, and about fifteen per cent is covered by lakes. Of the remainder, probably half is swamp and half dry land, covered with poplar. Many of the swamps could be easily drained and would make good farming land, while the poplar land is first class for farming. The best land is usually found bordering on the larger lakes, while the smaller lakes are frequently surrounded by swamps. Many of these small lakes have no outlet and sometimes no inlet, and the larger lakes have but small outlets. The variation in the elevation of the water in the lakes is also very small, probably not more than two feet at the greatest. The combination of the lakes and swamps makes a vast reservoir for the conservation of water supply.

The only stream of importance touched by our survey was Whiteshell river. This river consists of a series of lakes connected by long stretches of river with very little current, but broken at intervals by small falls. It enters tp. 13-15-E in section 1, leaves in section 2, enters again in section 6, and finally leaves the township in section 18. In the latter section there is a fall of about twelve feet. As the river has a very constant flow one hundred horse-power could be developed at this point with but little expenditure for dams. Between this point and Winnipeg river there are many falls and rapids which would aggregate not less than one hundred feet. Many of these could be easily developed.

The most important lake in this area is lake George in tps. 14 and 15-15-E. This lake is approximately seven miles long and one mile wide, and along the shore are many sand beaches. It is a beautiful sheet of clear, fresh water and contains many islands. It abounds with trout and other kinds of fish, and its shores would make an ideal summer resort. It is, however, rather difficult of access at present. A fine club house belonging to the Manitoba Hunting and Fishing Club, is situated at the north end of the lake, and a number of squatters are located at the south end. These settlers are badly in need of a road. At present their only means of getting in is from Point du Bois across Winnipeg river and lake George by boat.

The traversing was completed and the party paid off on February 29, 1916.

APPENDIX No 60.

ABSTRACT OF THE REPORT OF F. V. SEIBERT, D.L.S.

SURVEY OF THE 27TH. BASE LINE BETWEEN THE FOURTH AND FIFTH MERIDIANS.

The party left Athabaska on April 21 with scows loaded with supplies for the season's survey, while the pack-horses were sent overland via Lac La Biche to McMurray. There they were taken aboard the scows and the whole outfit proceeded down the Athabaska to the latitude of the base line.

After building caches and cutting trails in the vicinity of the base line, we commenced the survey of the line at the Fourth meridian on May 22, and on June 12 we were again camped on Athabaska river with the line completed to within a few miles of the river. In the meantime I had had the country west of the Athabaska explored for trail. While some of the party were cutting trail and moving supplies we surveyed fourteen and a half miles of outline on the east boundary of range 9, two and a half miles north and twelve miles south of the base line. When the supplies were moved about fifteen miles west, work was continued on the base line west of the river, and on September 23, it was permanently closed on the Fifth meridian. The party left the line on September 25, and travelling by way of Wabiskaw and Sawridge, arrived at Edmonton on October 17.

The country east of Athabaska river for twelve miles on either side of the line has very little agricultural value, being mostly muskeg and ridges of sand or boulders. Ranges 1, 2, and 3 contain most of the boulder ridges, while the other ranges contain most of the sand ridges. This whole area should be made a forest reserve. Very little merchantable timber grows there now, except along the streams. This has been chiefly the result of fires, as owing to the sandy nature of the country fires start easily, and judging from appearances, they have been sweeping the country every few years. The soil is very light and the growth does not start readily. With care I believe it can be made to produce considerable timber, mostly jack pine, but on the other hand continuous fires will leave it only a desert.

Athabaska river crosses the line in range 9. The valley is shallow and averages a mile in width, while the river channel averages one-half mile wide, with many islands and sandbars. The depth of the water varies with the season, and is always sufficient for steamboats of shallow draft. Some good spruce grows along the banks, and the land in the river flats is all good.

West from the Athabaska to the foot of Birch mountains in range 12 the country is rolling, with some large areas of muskeg. The dry land is light, some of it sand, and the remainder a sandy loam. Jack pine and spruce are the main timbers. Near the foot of the mountains more clay is found and the timber is larger, with more spruce and poplar and less jack pine. McIvor river in range 12, though crooked, is navigable for canoes north of the line. Its main source is in Birch mountains, and it is a typical mountain stream. During two days' rain in July it rose eight feet.

Birch mountains, beginning in range 12, are largely glacial deposits. A few limestone and sandstone ledges were noted on the eastern slope, but most of the cuts, and there were many, show boulder clay. The summit, in ranges 13, 14, and 15, is a plateau, largely muskeg and low jack pine ridges of sand, gravel, and boulders. The northern slope lies a few miles north of the base line. It is very steep in ranges 12 and 13, but towards the west it becomes gradually less steep. This slope is heavily timbered with spruce, poplar, and birch. All the creeks running out of

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the mountains have large ravines and gorges, some of which are 800 feet deep and extend into the hills from one to five miles. The country north of the hills has considerable land fit for agriculture.

There is no well-defined western slope. From range 15 the country slopes gradually west and north, and on this slope there is much land fit for agriculture and many areas of spruce and poplar of merchantable size. On the lower areas of this slope there is more open land, and many fine meadows. None of the creeks in this area were navigable for canoes. Birch river in range 24 however, is navigable for twelve miles on each side of the line. The elevation of this river at the line is 848 feet, while the elevation of its mouth at lake Claire is 710 feet. This is a fall of about 140 feet in a distance of over 100 miles and would indicate that it has few rapids, and is probably navigable for the whole distance.

The profile of the line shows a more or less gradual slope from the Fourth meridian, elevation 1,265 feet, to Athabaska river, elevation 723 feet, a rolling line to the valley of McIvor river in range 12, elevation 803 feet, a rough and broken ascent, very steep in places, to the summit of Birch mountains in range 14, elevation 2,559 feet, and a gradual slope to the Fifth meridian, elevation 800 feet, with a number of deep creek valleys breaking into the slope. The levels show that the country can be easily drained, and that even the worst muskegs and swamps have good drainage possibilities.

East of Athabaska river feed for the horses was scarce. It was also scarce from the river west to range 18; beyond that it was plentiful.

The dry weather in August and September helped very much in the progress of the work, making the muskegs easier to cross. It also improved the trail which we followed coming out. This trail in a wet season would be bad in many places, particularly from township 104 to Chipewyan lake.

Many bears were seen east of the Athabaska, and west of the river wolves were plentiful. Other fur-bearing animals were scarce due no doubt to the scarcity of rabbits. Jackfish were seen in nearly all the lakes and streams and whitefish were seen in Athabaska river and some of the lakes to the east of it.

No minerals were noted.

APPENDIX No. 61.

ABSTRACT OF THE REPORT OF H. M. R. SOARS, D.L.S.

STADIA SURVEYS IN THE VICINITY OF EDMONTON.

The party was organized at Edmonton, and on May 21, we left for our first work in tp. 51-23-4.

During the first part of the season we made stadia surveys of all lakes and sloughs over five acres in extent and investigated all water areas in townships 48 to 50, inclusive, ranges 22 and 23, and townships 48 and 49, range 21, all west of the Fourth meridian.

The character of the land is fairly uniform throughout these townships; the surface is rolling or undulating with many poplar bluffs. Lakes and sloughs are very numerous, and the feed both in the sloughs and on the uplands is abundant. There is ample wood for fuel and fencing. The district is well settled and improved, particularly in range 23. The settlers are of mixed nationalities, with Germans and Russians predominating.

The Edmonton-Camrose branch of the Canadian Northern railway crosses this block of townships from the southeast to the northwest. The main business and shipping centre is at Hay Lakes station in sec. 7, tp. 49-21-4. Considerable quantities of cream and butter are shipped from this point to Edmonton and Camrose. The trail from Hay Lakes to Edmonton, which parallels the railway through these townships, is rough and heavy, and the side trails are almost impassable in the spring and after heavy rains. The main trail is not travelled very much, as supplies can be purchased at Hay Lakes at reasonable prices. Very little road improvement seems to have been done during the last few years. There is however a fairly good trail connection with the Canadian Pacific railway to the west.

The largest sheet of water in this district is Big Hay lake in townships 48, ranges 22 and 23. This is more of the nature of a large slough than a lake: the water is not very good, and it contains no fish.

Owing to the fact that a certain amount of drainage has been carried into it from the north and that the south outlet has become badly choked up, this lake has overrun its old shore lines and much valuable hay land has become inundated. The water has also backed up into the tributary sloughs and mud holes, causing the adjacent roads to be very heavy. The present north shore line of the lake appears to be about two miles north of the old shore line and the water on this new area is from two to four feet deep. Until the outlet is cleaned out and deepened this lake and the many adjacent lakes and sloughs will be far above normal. Little Hay lake in townships 48 and 49, range 21, has also increased in area through the obstruction of its outlet, and much valuable hay land is now flooded. Township 50, range 22 has almost one-third of its surface covered with large and small lakes and sloughs, all of which will eventually be drained as the land increases in value.

Another large lake of very different character is Miquelon lake in townships 49, ranges 20 and 21. I traversed that part in tp. 49-21-4, the remainder having been traversed in 1912. A depth of forty feet was found on the east boundary of this township and it is doubtless deeper in tp. 49-20-4. The water is good and there are very few reeds, although in the fall the surface becomes covered with small green algae, giving it a scummy appearance. No outlet or inlet was noticed and I am given to understand that no outlet of any kind exists, thus explaining the absence of fish. The

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banks are well defined, in many cases being clay cut-banks. The surrounding country for four or five miles back is rough and densely wooded with poplar and willow.

The crops through all these townships were exceedingly heavy in 1915, oats and wheat in some cases averaging one hundred bushels and sixty-five bushels per acre, respectively. The vegetable crop was also very heavy. Hail and early frosts do not seem to be prevalent, and it is exceedingly rare that a crop failure is reported. The whole district seems to be most suitable for mixed farming.

We next moved over good trails to townships 57, 58 and 59, ranges 18 and 19, investigating on the way townships 50, ranges 17, 18, 19 and 20, townships 51, ranges 16 and 19 and township 54 range 17. These latter townships do not contain so many water areas as those to the west, but the character of the surface and the vegetation is very similar. Some traces of alkali were noticed in the townships south and east of Beaver-hills lake. The roads are good, and the district is well served by railways. The main lines of the Canadian Pacific and Canadian Northern railways as well as a local branch from each, cross these townships. The crops were exceedingly heavy and were not touched by hail or frost.

From there north across Saskatchewan river the settlers are nearly all German, Austrian and Russian. Smoky Lake post office in tp. 59-17-4 is the centre of a thickly-populated Bukowinian settlement; many large well-built churches were seen, and the settlers appeared to be prosperous. This district was originally covered with a dense growth of poplar, but a large acreage has now been cleared, and many good farm buildings are in evidence. Unfortunately the district here was hailed out in 1915.

On completion of townships 58 and 59, range 18, a move was made across the Saskatchewan to townships 57 and 58, ranges 18 and 19.

The country here does not appear to be quite as fertile as on the north side of the river; there are many jack pine sand ridges rising out of numerous large marshes, especially in tp. 57-18-4. Nevertheless every available quarter-section is taken up by a Galician or Bukowinian. A good trail extends from this district to Lamont on the Canadian Northern railway, and an excellent trail runs along the north bank of the river to Edmonton. A new branch of the Canadian Northern railway is in course of construction from Oliver, near Edmonton, along the north side of Saskatchewan river to Battleford.

Camp was next moved to those townships immediately east of Edmonton. Naturally these townships have been settled and well improved for many years, excepting the east half of tp. 53-21-4 and that part of tp. 54-20-4 lying west of Cooking Lake Forest reserve. These parts are rather rough and are covered with brulé and small sloughs. The crops from this district were exceptionally heavy but some hail was experienced in tp. 55-22-4. For many years miners have worked the gravel bars in Saskatchewan river through these townships, and have often taken out from two to five dollars per day in very fine gold. The source of this gold supply has never been found, but it is not very far up the Saskatchewan, as no gold appears in the upper reaches, and yet after the spring floods the bars which have been worked out in previous years again pay for working. A great deal of soft coal is also mined from the banks of the river in this district.

On completion of these townships we moved south again to complete the survey of a number of lakes in the south half of tp. 48-22-4, which could not be done economically until the ice had formed.

The last work of the season was some miscellaneous surveys in tp. 51-3-5 and tp. 58-3-5. The party was disbanded at Edmonton on November 30.

APPENDIX No. 62.

ABSTRACT OF THE REPORT OF N. C. STEWART, D.L.S.

SURVEYS IN THE REVELSTOKE DISTRICT, BRITISH COLUMBIA.

On April 17, I left Golden with my party and pitched camp at Glenogle, a station about seven miles up Kicking Horse river from Golden. From this camp we traversed Kicking Horse river through townships 27, ranges 20 and 21, west of the Fifth meridian, and surveyed all the quarter-sections of these townships through which the Canadian Pacific railway passes. Near the E. By. sec. 6, tp. 27-20-5, the river enters the lower canyon, which extends in a westerly direction for about seven miles. Surveying in this canyon was very difficult owing not only to the hard climbing, but also to the fact that the river could be crossed only in a few places. There is practically no agricultural land along the river in these townships.

On May 18, we moved to Palliser station in tp. 26-20-5, whence we continued our work along the railway, and on June 8, we moved to Leancoil. The next day we took the trail to the south travelling seventeen miles, and on the 9th we pitched camp near where Kootenay river crosses the south limit of the railway belt. Several days were spent in taking in the remainder of our supplies from Leancoil and in cutting trails. On June 14, we moved to the southeast quarter of sec. 13 tp. 25-17-5 and began the survey of the belt limit eastward from the SW. cor. sec. 18, tp. 24-16-5.

On June 18, we extended our trail to the northeast quarter of section 20, where good feed for the horses was found at the foot of snow slides. By cruising ahead it was found that we could not take our horses over the summit of the Vermilion range, but that by man-packing, a light outfit could be carried over to the headwaters of a creek running into Vermilion river. It was therefore decided to send the pack-train around via Field and Castle Mountain with all the outfit which could be spared, leaving the main party to man-pack a fly-camp outfit across the summit, and construct a trail out to the Banff-Windermere road to connect with the pack-train when it got around. This plan was carried out but with extreme hardship owing to the weather conditions. During the night of June 25, six inches of snow fell, and on the next day as much more. On June 27, we moved over the summit, taking turns in breaking a trail through the fresh snow; it took us eight hours to go three miles. We had several narrow escapes from snowslides, and were all suffering from sunburns and snow-blindness. On June 29, we cut a trail out to the Banff-Windermere road; the pack-train reached camp the next day.

From the middle of section 20 to the southeast corner of section 33, the belt limit is situated above timberline on high and in some places, inaccessible peaks. The line crosses the summit of the Vermilion range at approximately 8,200 feet above sea-level. On the west side of this range there are numerous cirque lakes and snow-fields, and on the east side are large glaciers, snowfields, and moraines. The glaciers on the east side are the sources of creeks which tumble down the mountain sides into a heavily-wooded valley nearly 2,000 feet below. The main stream, which is about fifty links wide and three feet deep, flows in a northerly direction through sec. 33, tp. 24-16-5, and secs. 4, 9, and 16, tp. 25-16-5, and then easterly through section 22 to Vermilion river. The belt line descends into the creek valley and then crosses a high ridge into the valley of Vermilion river. Timberline is again reached on the S. By. sec. 10, tp. 24-16-5, the southeast corner at that section being over 8,000 feet high. The eastern slopes of this ridge are very precipitous, being composed of shale cliffs and steep shale slides, over which we could not chain. We were delayed on this ridge by wet, misty weather and a snowstorm or two.

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The line crosses Vermilion river in the northeast quarter of sec. 15, tp. 25-16-5; at this point the river is three chains wide, between four and five feet deep, and very swift. The line then crosses the Banff-Windermere road and ascends the sides of Vermilion peak, passing about two chains west of the summit at an altitude of 8,500 feet, and again abruptly descends into Vermilion valley.

Through townships 26, ranges 16 and 15, the belt limit zigzags up the densely wooded valley of Vermilion river, which there flows in a southwesterly direction. In sec. 16, tp. 26-15-5, the summit of the main range of the Rocky Mountain system was reached at an altitude of 8,300 feet, and a tie was made to a cairn established on the boundary between Alberta and British Columbia by the Interprovincial Boundary Commission in 1913.

The valleys of the Vermilion and its tributaries are heavily timbered with marketable spruce and balsam. The timber is easily accessible, though most of it is in the park reserve. On some of the tributaries mining claims have been staked, and some of these are still being worked. The ochre and marble deposits along the wagon road are fairly well known.

Big game, consisting of moose, elk, deer, goats, mountain sheep, mountain lions, and bears is plentiful in the valleys of Kootenay and Vermilion rivers. Fur-bearing animals such as beavers, mink, and martens are also plentiful and porcupines are too plentiful. Ptarmigan were seen on the high peaks, and the Kootenay and its tributaries teem with trout.

Having completed this part of the belt line, we moved on August 5, to Castle Mountain and the next day to Golden, where we repaired and replenished our outfit for another hard trip to the south limit of the railway belt in tp. 24-22-5. We left Carbonate Landing on August 10, and reached Copper creek late that evening. The trail is in very poor condition, chiefly on account of rotten bridges and corduroy. On August 11 and 12, we built a bridge across the middle fork of Spillimacheen river and re-opened the old trail up Copper creek to the northeast quarter of section 2, tp. 24-22-5, and on the following day moved our camp to the end of the trail.

Our work consisted in retracing the old surveys in Copper creek valley in townships 24, ranges 21 and 22, and in making ties by triangulation to Amyot triangulation station. Copper creek valley is about 6,000 feet above sea level, and the mountain tops adjacent to it are all above timberline. The slopes of these mountains are very rough and broken and covered with slide paths, while the bottom of the valley is filled with boulders and debris from the slides. At the head of the valley there are several glaciers. Spillimacheen river valley is noted for grizzly bear hunting. At one time there was considerable mining in the district.

On August 23, we moved to tp. 27-22-5 where we surveyed the south and west boundaries of section 34 and completed the traverse of Columbia river. We then moved camp to Moberly in tp. 28-22-5, where we surveyed parts of sections 4, 8, and 16, and completed the traverse of Columbia river as far as the north boundary of section 19.

On September 20, we commenced subdivision work in the southeast quarter of tp. 29-22-5, in the valley of Blaeberry river. This was completed by October 1, and we moved back to the mouth of the Blaeberry in tp. 28-22-5, where we surveyed parts of section 20, and completed the traverse of Columbia river.

On October 11, we moved to Golden and on the following day made some alterations in the survey of the northeast quarter of sec. 8, tp. 27-22-5, after which the party was disbanded for the season.

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APPENDIX No. 63.

ABSTRACT OF THE REPORT OF P. B. STREET, D.L.S.

SUBDIVISION SURVEYS ALONG THE HUDSON BAY RAILWAY IN NORTHERN MANITOBA.

My surveys of last season were made during the fall and winter months, and were confined to the lands along the Hudson Bay railway in townships 71, 72, and 73, ranges 2, 3, 4 and 5, west of the Principal meridian.

I left Pas with my party on August 4, and travelled by train on the Hudson Bay railway to mile 172, near where our first camp was located. The only accommodation train running on this line is a mixed one, which is operated by the Hudson Bay Construction company, and which makes a weekly trip to the end of steel. The trip takes a day and a half, each way.

The railway was being ballasted last summer and autumn, and gravel trains sped past our camp at thirty-five miles an hour, which speaks well for the condition of the road-bed.

The greater part of the district surveyed is covered with a thick growth of timber, but most of it is too small to be of commercial value. Some larger timber is to be found in places, but this is all being used for railway ties. The soil is for the most part clay, and is stony in places.

Townships 73, ranges 2 and 3, are badly cut up by Landing and Wintering lakes. These lakes have steep rocky shores, and are fairly deep, forty feet being a common depth at the centre while a depth of twenty feet is usually found within fifty yards of the shores. Fishing is carried on in both lakes, whitefish, tullibee, jackfish, and pickerel being plentiful. The district between these lakes is noted for its almost impenetrable thickets of small spruce.

Our work was completed on March 22, and the party was disbanded at Pas on the 24th.

The winter season of 1915-1916 was unsatisfactory for survey work owing to incessant winds and repeated snowfalls. The temperature was not as low as the average winter, but high winds made work in the open much more unpleasant. I have never before seen so much suffering from repeated frost-bites as the men were compelled to endure. The track of the Hudson Bay railway was covered with snow practically all the time, and we were unable to use our hand-car from December 1 up to the time we stopped our surveys for the season.

The lack of game was one of the unusual features noticed on the trip. The country bordering on Wintering and Landing lakes should be excellent for chickens and partridges, as berries are plentiful, and the land is dry and clean. No partridges were seen, however, and practically no ducks. No signs of moose were noticed until late in January, when the excessively deep snow in this district evidently attracted them as a refuge from the timber-wolves. As there was no crust on the snow a wolf would not travel over it. No wolf tracks were seen all winter, but lynx were plentiful, eight being caught by one of my men, who set snares and traps along our survey lines.

No indications of minerals were seen. We ran across several mineral claims which were staked some time ago and subsequently abandoned.

A fox farm was started near Thicket portage in township 73, range 2, but the venture was not a success this season owing to an epidemic which affected most of the fox farms in this country. The owner had thirty-two full grown foxes in January, and lost twenty-nine by the first of March.

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A fur trader and general merchant, who has about half an acre of garden at mile 185 on the railway, succeeded in raising excellent vegetables last summer. At a contractor's old camp at mile 169, in township 71, range 4, a splendid growth of timothy hay, perfectly ripened, was seen last August, the hay having come up wild from seed dropped in feeding horses at this spot. Frosts occur late in August and in early September, but evidently do not affect the growth in the early summer.

The Hudson Bay railway has been completed to mile 237, the first crossing of Nelson river. A steel cantilever bridge was built over the river at this point during the winter, and as the grade was finished up to mile 320, it was the intention to proceed with the track-laying as soon as the snow disappeared. At mile 320 the railway crosses the Nelson a second time, so there will be some delay while a second bridge is being erected.

APPENDIX No. 64.

ABSTRACT OF THE REPORT OF A. G. STUART, D.L.S.

RETRACEMENT OF BASE LINES AND MERIDIANS IN SASKATCHEWAN AND ALBERTA.

My instructions called for the retracement of the 9th base line between the Second and Fifth meridians, of the Fifth meridian from the northeast corner township 32, to the northeast corner township 14, and of the Fourth meridian from the northeast corner township 51, to the northeast corner section 1, township 62, where a series of latitude observations had been taken several seasons previous.

On April 23, I left Kamsack, Saskatchewan, where my party was organized, and proceeded by wagon across Kee-See-Koose Indian reserve to where the retracement work was commenced at the NE. cor. sec. 36, tp. 32-1-2.

In connection with the retracement surveys a line of precise levels and an independent line of check levels were run. In order to obtain a commencement datum, a tie-line was run from rail level at Pelly station on the Canadian Northern railway to our commencement point at the intersection of the 9th base and the Second meridian. During the summer as the work progressed, water levels at all lakes and streams, and rail elevations at all railway stations near the line, were obtained. Bench-marks were established in most of the villages, towns and cities in the vicinity of the retracement, and connections were made with several bench-marks previously established on other important lines of levels.

The 9th base line, as far as Quill lake in ranges 17 and 18, west of the Second meridian, passes through bush country and in places there are long stretches of low, swampy land. This section of the country is well adapted for mixed farming, sufficient rainfall being assured owing to a large area of timbered land. There is, however, great need for improvement in the building of roads, as in many places there is no road opened along the base line. The settlers, who are mostly of foreign birth, are thrifty and industrious, but they are handicapped by lack of capital, and primitive methods of farming have greatly retarded their progress.

West of Quill lake the country is mostly open prairie, with excellent roads and railway connections available in all directions. The main exception is in ranges 19, 20, and 21, west of the Fourth meridian where some broken hills were encountered, and where the country is exceedingly rough; this district is used for grazing purposes. Roads were not accessible on many of the section lines and transportation became difficult. The agricultural resources of the country are being well developed, and the crops were in splendid condition. We reached the Third meridian on June 4, the Fourth meridian on July 13, and the Fifth meridian on August 20.

After the completion of this base line retracement was continued south along the Fifth meridian, Calgary being passed about September 1. South of Calgary Bow river crosses the meridian in several places. The current in this river is swift and treacherous and the water cold, and as no boats of any description were available, work became difficult to perform and a series of large triangles for obtaining chainage had to be resorted to. In this region and southerly along the meridian considerable bush country was crossed, much cutting being required in order to produce the line. The nature of the country changed to heavily rolling prairie and many grazing herds were seen. The only available roads were some distance from the meridian. On September 18, we reached the northeast corner of township 14, where the work on the Fifth meridian was discontinued.

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We then travelled east to the railway where the party, with the exception of four men, was discharged. We then proceeded by way of Calgary and Edmonton to Lloydminster, and thence northerly by wagon to the NE. cor. tp. 51-1-4, where we commenced the retracement of the Fourth meridian on September 29. We found the country heavily wooded with poplar, tamarack, spruce, jack pine, willow, and scrub, and as the old lines were grown up a great deal of cutting was necessary. Several half-breeds who were excellent axemen and woodsmen were engaged at Onion Lake and the work proceeded as rapidly as possible. The only road available for transportation was an old trail which leads to Cold Lake I. R. and which is about five miles distant from the meridian; this necessitated long hard walks to and from work. In township 58, the road turned westerly and as the country to the north as far as Beaver river was heavily wooded and swampy in many places, it became necessary, in order to complete the retracement, to make rough pack-saddles, and use a small pack outfit for the remaining nineteen miles of line. This was completed to the NE. cor. sec. 1, tp. 62-1-5, on October 19.

Moose and caribou were very plentiful in this district. It is very interesting to note that at a reserve west of this locality it was reported that the Indians were threshing between twenty and thirty thousand bushels of their own grain.

During the field season 677 miles were retraced, necessitating the taking of 500 azimuth observations. These lines were also levelled and check levelled, and in addition to this many level tie-lines were run.

APPENDIX No. 65.

ABSTRACT OF THE REPORT OF C. H. TAGGART, D.L.S.

SURVEYS IN THE KAMLOOPS DISTRICT, BRITISH COLUMBIA.

The first work of the season was in tp. 18-15-6, where we completed the subdivision of that part of the township lying outside of Monté Hills Forest reserve.

Most of this township is used for stock ranging purposes for which it is well suited on account of the abundance of water and the heavy growth of bunch grass. This year the grain crops on the cultivated parts were excellent.

Campbell creek in range 16 draws most of its supply of water from the western portion of the forest reserve. A good deal of inconvenience was caused to the farmers lower down the creek who use its waters for irrigation purposes, by the beavers damming back the headwaters on Scuittoe creek and other tributaries.

A few of the homesteaders hunt and trap in the forest reserve during the open season and appear to have very good success, especially at trapping. Deer are rather scarce and difficult to find.

The outfit was next moved to tp. 19-15-6, where the boundaries of lot 706 were retraced and tied to the Dominion Lands system of survey. This lot is a valuable hay and cattle ranch. Sufficient land is now cleared to produce hay to winter 500 head of cattle. The owner irrigates the greater part of the land by flooding it in May for a depth of from a few inches to a foot or more; when warm, growing weather comes the water is drained off.

The next move, which required nearly two days, was along the Kamloops-Vernon wagon road to tp. 17-11-6. The survey of sections 26 to 30 was made, thus completing the subdivision of the northerly portion of the township outside of Fly Hill Forest reserve and timber berth No. 441. These sections lie on mount Connaught which is 1,500 to 2,500 feet above the valley and is densely timbered on top.

Several mining prospects were noticed on this mountain, particularly on the southern slope, which is openly timbered with pine and easily prospected. A large number of location posts were noticed but nothing of great value seems to have been found.

The Canadian Northern railway branch line from Kamloops to Vernon has been located and surveyed through Salmon river valley in this township. Naturally it has been a keen disappointment to the settlers but probably more so to the land speculators, that construction work on the railway has not been commenced. It would in all probability have been commenced two years ago had it not been for the financial depression.

The survey of the railway belt limit across ranges 11 and 12 was the next work undertaken. For this purpose the camp was moved to section 18, township 17, range 10. After running about a mile of line a fly camp was taken by pack-train into section 11, whence the belt boundary was carried to the northwest corner of section 10. In order to take the pack-train into this section it was necessary to open out a hunter's trail, which followed Moffat creek as far as the tributary leading into section 11. In places where this trail was unsuitable it was necessary to open out a new trail.

We then moved back to the bridge on Salmon river near the middle of range 11, from which point we completed the belt line across the range, and produced the interior meridians down to the belt line.

The camp was next moved to a point near the west boundary of range 11, whence the belt boundary was produced into range 12, after which we moved by pack-train

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to Pinaus lake. The work was completed from this camp. Some subdivision was also performed in sections 18, 19, 29, and 30 of this township.

The valley of Salmon river, which crosses this township, is very fertile and is devoted to mixed farming. The climate is comparable to that of some parts of western Ontario.

We next moved to sec. 6, tp. 18-11-6 and completed the subdivision of the southwest portion of this township lying outside Fly Hill Forest reserve and from there moved to Paxton valley in tp. 18-13-6. The subdivision of sections 9, 10, 14, 15, and 22 to 26 in this township was completed and the boundary of Martin Mountain Forest reserve was surveyed.

This completed the eastern end of the season's work. The outfit was moved to Kamloops, and from there up North Thompson river road as far as sec. 26, tp. 22-17-6, where a small survey was performed. From there we moved to lot 371 G. I. in tp. 20-19-6, where the boundaries of this lot and of lot 2, G. II were retraced and tied to the Dominion Lands system. The adjoining mineral lots were also tied in.

We next moved to Cornwall's ranch in tp. 19-19-6, and completed the subdivision of the portion of this township lying outside of Long Lake Forest reserve. Portions of this land are suitable for agriculture and are already entered for. Grain farming and stock ranching are carried on with success. Parts of secs. 26 and 27, tp. 19-18-6 were also surveyed while we were in that vicinity.

The outfit was then moved back to Kamloops and from here to Pinantan lake in tp. 20-15-6, where the survey of sections 14 and 23 were completed. Only a small portion of these sections is suitable for agriculture; stock could be grazed on part of the remainder. The soil is heavy clay and would probably be very productive.

The party returned to Kamloops on October 15, and was disbanded for the season.

The weather conditions during the first part of the season were very unfavourable for survey operations. From the time we moved to Salmon river valley until we left Pinaus lake rain and fog were of almost daily occurrence. Particularly at the higher altitudes rain fell very frequently. At the end of May snow fell on Mt. Connaught and Mt. Tuktakamin. The fact that the yield of grain in the dry unirrigated areas of the Kamloops district was twice or three times the usual amount shows that the rainfall was abnormal. During the latter part of the season the weather was fine.

APPENDIX No. 66.

ABSTRACT OF THE REPORT OF G. A. TIPPER, D.L.S.,

SUBDIVISION SURVEYS IN THE GRANDE PRAIRIE DISTRICT, ALBERTA.

My surveys for the season of 1915 consisted of the subdivision of township 77, range 4, township 76, and the southerly two-thirds of township 77, range 6, and townships 77 and 78, and the east half of township 76, range 7, all west of the Sixth meridian.

I left Edmonton, where my party was organized, on April 25, and travelled by the Edmonton Dunvegan and British Columbia railway to the end of steel, which at that time had reached Reno, a station about thirty miles from Peace River Crossing. From there we travelled by wagon via Peace River Crossing, Dunvegan, and Spirit River settlement to the scene of our first work in tp. 77-4-6, where we arrived on May 8.

The trails from Reno to our destination were in very poor condition owing to the fact that the frost was just coming out of the ground, and to the excessive rains. It is perhaps worthy of note that when our surveys commenced on May 8, the frost was practically all out of the ground.

The area covered by my surveys is mostly rolling and lightly wooded. The main exception is a range of hills about 175 feet in height known as White mountain, extending from sec. 20, tp. 77-6-6, westerly through the middle of tp. 77-7-6. From the summit of this range an extensive view of the surrounding country can be obtained and the Waterhole district which is twenty-five miles distant across Peace river can be seen quite plainly. These hills are mostly heavily wooded with spruce.

Spirit River settlement which lies in townships 78, ranges 5 and 6, is a thriving community. A townsite of the same name has been located in sec. 22, tp. 78-6-6. The road-bed of the Edmonton Dunvegan and British Columbia railway was graded as far as this townsite and it was expected that steel would be laid that far shortly after the close of our surveys.

By September 21, we had completed our surveys with the exception of some traverses. Most of the party were therefore sent to Edmonton and disbanded. The remainder after completing these traverses reached Edmonton on October 16.

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APPENDIX No. 67.

ABSTRACT OF THE REPORT OF J. W. TYRRELL, D.L.S.

SUBDIVISION SURVEYS NORTH OF LAKE ST. MARTIN.

My field work for the season of 1915 consisted of the subdivision of a strip of land about three miles wide, on each side of Dauphin river from lake St. Martin to lake Winnipeg.

This district may be reached by boat either from lake Winnipeg via Dauphin river, or from Fairford, on the Canadian Northern railway via Fairford river, lake St. Martin and Dauphin river. The latter route can be used to advantage with small boats or canoes but is not suitable for large vessels. Dauphin river has a few slight rapids, but none that cannot be easily navigated by small boats or canoes although tracking has to be resorted to in places.

There is a well-travelled road leading from Fairford through Sandy Bay and Lake St. Martin Indian reserves, as far as the 9th base line which was the southern limit of our work. From there we cut a road following near the west bank of lake St. Martin and the left bank of Dauphin river throughout its length. The road is fairly good in dry seasons of the year, but it is too soft for heavy loads in wet seasons. The railroad to Gypsumville might easily be extended through this district. Some location surveys have already been made through tps. 34 and 35-7-Pr. and tp. 35-6-Pr.

Dauphin river is of the greatest value to this district, forming as it does an excellent water route, furnishing an excellent supply of fresh water, and providing good fishing. It is from five to ten chains in width and from six to twelve feet deep except in a few places where there are rapids, and flows at a rate of two to four miles per hour. We found that we could use boats and canoes carrying a ton or more, by using tracking-lines when ascending the rapids. By doing some dredging in the rapids this river could be made navigable for fairly large boats. Throughout the lower half the banks of the river are from eight to forty feet high, so that by damming considerable power could be developed.

Jumping river which flows in a northeasterly direction from the NE. cor. tp. 35-6-Pr. to lake Winnipeg, is also a useful river for transportation being from ten to fifteen feet wide and about six feet deep with a current of about three miles per hour.

There is some excellent timber, suitable for milling, in the northern part of tp. 37-7-Pr. and the northeastern part of 34-5-Pr. The remainder of the district is nearly all covered with small timber which will be useful to the settlers as fuel, and for building purposes but it is not enough for lumber.

The chief industries of the district will likely be farming and grazing. There are some excellent hay meadows from one-quarter to three-quarters of a mile wide along the west and north of lake St. Martin and along both sides of Dauphin river extending from its head as far as the elbow in tp. 35-7-Pr. and a number of smaller meadows in tp. 35-6-Pr. These meadows are exceptionally suitable for grazing purposes.

The east halves of tps. 33 and 34-7-Pr. and the southeast quarter of tp. 35-7-Pr., are chiefly rolling land, covered with small timber, with a number of swamps. There is also a similar area one-quarter to one-half mile wide on each side of the lower half of Dauphin river. The soil in these areas is chiefly black loam to a depth of four to six inches, with clay subsoil. They could all be drained into Dauphin river and lake St. Martin and thus made into good farm land. Townships 33, 34 and 35, range 6,

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and townships 34 and 35, range 5, are chiefly composed of spruce and tamarack swamp covered with moss to a depth of two to four feet, with black muck beneath. This district could be easily drained into Dauphin river, but it would require considerable time to convert the moss and muck into good farm land.

Moose, elk and caribou and smaller game such as mink, muskrats, weasels, etc., are numerous in the whole of this district, and whitefish, pickerel and jackfish are quite plentiful in lake St. Martin, Dauphin river, and lake Winnipeg, affording another industry of considerable importance.

On the whole, however, this district is best suited for farm settlement. Within the last year a number of settlers have taken up land in the surrounding townships and a few have already settled in the southern part of the newly-surveyed district. With a little capital and intelligent development work on the part of these settlers, there is every prospect that the Dauphin river district will soon become a prosperous mixed-farming and stock-raising settlement.

APPENDIX No. 68.**ABSTRACT OF THE REPORT OF W. H. WADDELL, D.L.S.****SUBDIVISION SURVEYS NORTH OF LAC LA BICHE.**

The work on which I was engaged during the past season consisted of the subdivision of townships north of Lac La Biche along the right of way of the Alberta and Great Waterways railway between the 19th and 21st base lines. The grade of this railway is completed to McMurray but the steel is laid only as far as tp. 78-7-4.

The area subdivided contains very little land suited to general agricultural pursuits, being for the most part composed of muskeg separated in nearly all cases by sand or heavy clay ridges with very little fertile surface soil. Very small areas of this fertile soil are found along some of the streams, but these form an insignificant portion of the area subdivided, and it is very doubtful that even this is of much value in the present undeveloped state of the district, as killing summer frosts appear to be very frequent. Attempts were made to raise some garden produce along Christina river during the summer, but this was practically a total failure. It is possible however that should an extensive system of drainage be undertaken and I believe that the muskegs could be drained comparatively easily, a great part of the district could be reclaimed. This would also remove the cause of the severe and frequent frosts.

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APPENDIX No. 69.

ABSTRACT OF THE REPORT OF C. M. WALKER, D.L.S.

MISCELLANEOUS SURVEYS IN MANITOBA, SASKATCHEWAN AND ALBERTA.

My work was of such a scattered nature that it was thought advisable not to organize a regular party. Accordingly I was accompanied by an assistant only, and hired labourers locally as they were required.

Our first work was the subdivision of lands suitable for summer resort lots, bordering on Sandy lake in sec. 9, tp. 18-20-Pr. The southern shore of this lake is admirably suited for a summer resort. The sandy beach has a very gradual slope and the water in summer is sufficiently warm for bathing. Wooded islands are scattered throughout the lake which is about five miles in length, and splendid fishing is to be had in this and the adjoining lakes, of which there are many.

At the time of my survey the resident population of Sandy Lake village numbered about 100, but I was told that during the summer months of an average season from 800 to 1,200 persons may be found in the tents and cottages in the immediate vicinity. It can be reached by Canadian Northern railway and there are good automobile roads connecting it with the towns to the east, south and west.

The surrounding district is well suited for mixed farming and the northern end of the lake adjoins Riding Mountain Forest reserve, which is plentifully supplied with large game such as moose, caribou, elk and deer.

Our next work was the survey of a small settlement near Badger station on the Canadian Northern railway in sec. 6, tp. 3-12-E. A number of half-breeds and others had squatted on this section and are making a living by cutting cordwood in the surrounding district. This district is mostly composed of sand ridges, thickly covered with jack pine and spruce, and it is of little value from an agricultural stand-point. During the summer months the settlers help to make out an existence by gathering and shipping to Winnipeg large quantities of blueberries, blackberries, and raspberries, which grow in great profusion along the sand ridges.

On completion of this work we moved to the village of Woodridge in sec. 3, tp. 4-10-E. to lay out lots for about thirty squatters. After considerable difficulty a plan of subdivision was agreed upon which apparently gave satisfaction, and about fifty lots were laid out.

We then moved to Banff, Alberta, and on June 14th, began work on the preliminary survey of an addition to the townsite of Banff, to be known as the St. Julien subdivision. We also made a preliminary survey of a cemetery site near Tunnel mountain and made some other minor surveys in the vicinity.

Our next move was to tp. 1-26-4, where an improperly placed monument was corrected, and from there to tp. 22-5-4 to traverse a portion of Elbow river through the township. We then spent several weeks on small miscellaneous and correction surveys in southwestern Saskatchewan. The townships visited were tp. 13-28-3, tp. 11-23-3, tps. 12, 13 and 14-23-3 and tps. 10 and 12-16-3.

Two weeks were spent in making further surveys at Banff and when this was completed on September 9, we again returned to southwestern Saskatchewan where we were employed for about six weeks on further miscellaneous surveys in tp. 18-18-3, tp. 18-19-3, tps. 19 and 20-15-3, tps. 15 to 18-7-3, tps. 16 and 20-6-3, tp. 16-1-3 and tp. 15-5-3.

On October 18 we moved to tp. 3-22-Pr. and subdivided the dried-up bed of Whitewater lake. This work occupied about two weeks and we again returned to Banff to make the final survey of St. Julien subdivision. This work was urgently required in order that a number of alien enemies who had been interned at Banff might be given winter employment, clearing the streets and avenues of the new subdivision. The Dominion Parks Branch supplied us with a number of labourers to assist in this survey which kept us busy until December 14 when we closed operations.

During the season observations for magnetic dip and total force were taken whenever our other work permitted.

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APPENDIX No. 70.

REPORT OF J. N. WALLACE, D.L.S.

LEVELLING IN MANITOBA, SASKATCHEWAN AND ALBERTA.

The work of last season was advanced along the same general lines as in previous years with the notable addition that levels were inaugurated in connection with the subdivision of townships.

Four classes of levels are now carried out. The first class consists of precise levels, almost invariably run along railway lines. All lines are run independently in both a forward and backward direction, and unless these duplicate lines agree within 0.017 feet in a mile section, the section must be levelled again. Practically the discrepancy seldom exceeds 0.010 feet in a single mile, with an accumulation well within 0.017 feet $\sqrt{\text{miles}}$.

The second class comprises levels run along travelled roads or other routes where no railway is available as a route. The main object of this class of levels is to supply, in the partly settled districts, lines which will radiate through the general system of levels, and will act as a control in keeping down the accumulation of error. These levels rank next in accuracy to precise levels. The discrepancy allowed is 0.030 feet $\sqrt{\text{miles}}$. The extent of these levels is very restricted owing to lack of available routes of almost any kind.

The levels run along meridians and base lines during their original survey form the third class. These were the first levels inaugurated and, at the present time, form much the greatest proportion (74.2 per cent) of the total mileage levelled. The lines nearly all run through districts which are timbered and are as yet devoid of settlement. The allowable discrepancy is 0.10 feet in a mile section, with an accumulation not greater than in proportion to the square root of the miles.

The fourth class are the levels which are run during subdivision of townships, the practice being to run these along alternate section lines, forming closed circuits of eight miles each.

Some reconnaissance levels were also run last season with a view to ascertaining the approximate elevations of streams, lakes, and other features scattered over partly-settled districts which had been surveyed before levels were inaugurated. The great difficulty in running such levels may be briefly stated as due to the impossibility of finding the difference of elevation of two points without having to run lines of levels, not desired in themselves, between the two points. It is not intended to continue these levels until some form of instrument may be available in which speed is given more attention than great accuracy. The best general design is a level in which the telescope is capable of being moved about ten degrees in a vertical plane, so that each time the instrument is set up, the line of sight can be elevated or depressed to suit the slope of the ground. The backward and forward rods are read as usual, and the sights subsequently corrected for each angle of slope.

The levels carried out during the twelve months are as follows:—

	Miles.
Meridian and base line levels.....	1,671
Precise levels.. ..	730
Subdivision levels	854
Other lines of levels	181
Total for the season	<u>3,436</u>

(The above does not include 168 miles of reconnaissance levels taken northeast of Edmonton.)

The total mileage is an increase of 622 miles over the total of the previous year. Meridian and base line levels show a decrease of 638 miles, while there was an increase in precise levels of 225 miles.

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The mileage of all levels run in each season since their inauguration is as follows:—

Season.	Meridian and base line levels.	Precise levels.	Other levels.	Totals.
	Miles.	Miles.	Miles.	Miles.
1905.....	114			114
1908.....	116			116
1909.....	613			613
1910.....	757			757
1911.....	1,326		116	1,442
1912.....	1,433	497	70	2,000
1913.....	1,992	567	72	2,631
1914.....	2,309	505		2,814
1915.....	1,671	730	1,035	3,436
Totals.....	10,331	2,299	1,293	13,923

It will be noted that the total of all levels now reaches the large amount of 13,923 miles.

Meridian and base line levels.

Seven parties were engaged in the survey of meridians and base lines, including one party on retracement of lines which were surveyed many years ago. All of these surveyors took levels. No work was done in the northeastern part of Manitoba near Hudson bay, as a large amount of work had been done there the previous year. Farther south in Manitoba the levels along block outlines run near the east shore of lake Winnipeg were continued southerly. These lines are required as a basis for future surveys, as there is no meridian available in that locality, owing to the lake interfering with access to the Principal meridian. The levels were continued on these lines during the past season from township 37 to township 27, and a connection was made, near their southerly end, across a narrow part of lake Winnipeg, to the levels run up from the south along the Principal meridian. The datum of the levels along the meridian had been derived from a precise bench-mark at Gretna, close to the international boundary, while the levels run southerly, near the east shore of lake Winnipeg, were run on an assumed datum. The connection across the lake, along the 8th base line, thus afforded a good datum for the levels on the east shore. The elevation of lake Winnipeg was taken frequently during the progress of these levels. Its average elevation for the months May to October is about 715 feet above mean sea-level.

Between the Principal and Second meridians sixty-eight miles were levelled between lakes Winnipeg and Winnipegosis along the 11th and 12th base lines, and forty-eight miles along outlines between the 11th and 13th base lines. The gap previously existing on the 15th base line between Playgreen lake and range 21, was also levelled this past season, and the part between this range and the Second meridian was relevelled. The levels on this base line and on the 16th base line were connected by a line along the east of range 21.

It was stated in last year's report that the system of levels had been connected with the tide-gauge at Nelson on Hudson bay. This connection has been worked out, and it is found that the elevations carried northeasterly over the lines of levels are 5.65 feet too high at Nelson, when compared with mean sea-level as recorded by the tide-gauge. The datum used in the system was derived from a bench-mark of the United States Coast and Geodetic Survey at Stephen, a place in the State

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of Minnesota about forty miles south of Emerson, Manitoba. The total length of the various connected lines of levels from Stephen to Hudson bay is about 1,580 miles. The last 435 miles of this distance consists of levels run during the original survey of meridians and base lines, which are run on a straight course across uninhabited country amid swamps and other very unfavourable surroundings. The closing, therefore, can be regarded only as a preliminary approximation, pending the completion of the precise levels over the last 320 miles of the Hudson bay railway.

It will be seen from the foregoing that 414 miles of meridian and base line levels were run last season in what may be termed the eastern part of the territory, that is the part east of the Second meridian.

In the central part, between the Second and Fourth meridians, levels were run along the 9th base line (north boundary of township 32) from the Second to the Fourth meridian, and were then continued westerly to the Fifth meridian. This line crosses a well-settled prairie country. Numerous connections were made to bench-marks of other intersecting lines, and the elevations of all important topographical features along or near the line were recorded. Levels were run by the same party to close a gap along the Fourth meridian between township 53, and township 60. There is now a continuous line of levels along the Fourth meridian from the international boundary to the south of lake Athabaska in township 115.

West of the Fourth meridian the 27th base line was levelled along its whole length and was closed on the Fifth meridian; also a short distance was levelled along the east of range 9, extending a few miles north and south of the base line. All the base lines from the 19th to the 27th inclusive have now been levelled between the Fourth and Fifth meridians, making nine connections in all.

In the country between the Fifth and Sixth meridians levels were run along the 24th and 25th base lines across ranges 1 to 17, west of the Fifth meridian, ranges 18 to 21 having been levelled in the year 1913.

The Sixth meridian levels were advanced 216 miles, being continued from township 90 to township 126, reaching a point two miles north of the north boundary of Alberta. This is the farthest north to which levels have yet been carried. The previous northerly records of the levels were the Fourth meridian levelled to township 95 in the year 1910, the Fifth meridian to township 112 in the year 1911, and then the Fourth meridian continued to township 115 in the year 1913.

The lengths of continuous levels along the several meridians is now as follows:—Principal meridian, (excepting lake Winnipeg) townships 1 to 88, 448 miles; Second meridian, townships 56 to 85, 171 miles; Third meridian, townships 53 to 72, 120 miles; Fourth meridian, townships 1 to 115, 686 miles; Fifth meridian, townships 71 to 112, 247 miles; Sixth meridian, townships 85 to 126, 252 miles; These undoubtedly include the longest straight lines of continuous spirit-levels in the world.

In addition to continuing the levels of the Sixth meridian to township 126, the same surveyor levelled the last sixteen miles of the 27th base and closed on the Sixth meridian; he also made a connection with the levels at the westerly end of the 29th base, this base having been surveyed in the previous year as far west as the Sixth meridian before the meridian had been surveyed so far north. There are now three direct connections along base lines between the levels of the Fifth and Sixth meridians, namely the 23rd, the 27th, and the 29th base lines.

Levels taken during the subdivision of townships.

Last season levels were taken for the first time in connection with the subdivision of townships by four of the subdivision parties. One of these was working in south-eastern Manitoba, one northeast of Prince Albert, one between Edmonton and Lesser Slave lake, and the fourth about fifteen miles northeast of the town of Peace River

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Crossing. The system followed was to take levels along such of the four outlines of each township as were being surveyed and in addition, along every alternate section line running east and west, and north and south, across the township. These lines form nine circuits of eight miles each. The levels along the meridian outlines are checked; the other levels are not checked, reliance being placed on the closings of the several circuits to detect errors. The limit of error allowed is that each mile of the meridian outlines should be checked by a second line agreeing within 0.10 feet, and that each eight-mile circuit should close within one foot. Allowing two of the outlines to each township, the lines indicated above comprise thirty-six miles of levelled lines to seventy-two miles of surveyed lines in each township. Adding the check levels, the leveller would have to run about 72 per cent of the final surveyed mileage.

Three of the subdivision parties levelled 264 miles, 260 miles, and 238 miles, an average of 254 miles, while the fourth party levelled 92 miles, making a total of 854 miles. The records made in the field include the elevation of the ground at every quarter of a mile along the lines levelled and of the water in all streams and lakes crossed by the lines. Sufficient information has been obtained to enable topographical plans of each township to be prepared to the extent of marking the positions of contours across the lines levelled and sketching in their connections from one line to the next. While the latter is not supposed to be an absolutely accurate representation of the ground, yet the connections of the contours from one crossing to another greatly assist in identifying the positions where a certain contour crosses the various lines of levels.

Lines of precise levels.

Precise levels were run along the Grand Trunk Pacific railway from Portage la Prairie to Goodeve, a distance of 247 miles, and along the Canadian Northern railway from Saskatoon to Rosebud, a distance of 339 miles, making a total of 586 miles. These levels were run strictly as precise levels. A third line was run from Grouard to Dunvegan by way of the town of Peace River Crossing, using the travelled road. While not run so strictly as the other two lines it has been included in the mileage of precise levels.

The line of levels along the Grand Trunk Pacific railway was carried out by Mr. L. O. R. Dozois, D.L.S., between May 10 and August 28, at an average rate of 67.4 miles of double line per month. Mr. Dozois adopted a new schedule of working hours in order to utilize those hours of the day which are most free from wind and disturbed air. The former is so bad on prairie work, except in the early morning and late afternoon hours, that many days are entirely unfit for precise levelling under the ordinary schedule of hours from 7 a.m. to 6 p.m. Mr. Dozois arranged the hours of actual levelling so that about four hours' work was done before 8.30 a.m., and another four hours' work after 4 p.m. The results showed a decided increase in accuracy and decrease in cost. The probable error of the mean result per mile of double levelling of this line, 247 miles long is -0.0022 feet, which equals the best class of levelling carried out anywhere.

Mr. E. W. Berry, D.L.S., had charge of the second line of precise levels which was run along the Canadian Northern railway. He commenced work at Saskatoon on May 14, and ended at Rosebud on October 20, having completed 339 miles at an average rate of 63.6 miles of double line per month. The probable error of the mean result per mile has not yet been computed, but an inspection of his discrepancies shows that it is very small. The accumulated discrepancy is -0.013 feet at the end of the 339 miles, with a maximum of -0.129 feet at mile 120.

The line from Grouard to Dunvegan was run by Mr. L. E. S. Bolton, D.L.S., between June 11 and October 8. Precise methods were followed but owing to the large percentage of re-running required to keep within the limit of 0.017 feet, this limit was relaxed to the extent of not requiring occasional miles to be rerun if the discrepancy was within 0.030 feet. The main object of this line was to supply a new and better

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datum for the Sixth meridian and all levels west of it than the former datum which had been dependent on the levels of the 23rd base line west of the Fifth meridian, long regarded as unsatisfactory. The length of the main line is 144 miles. In addition 32 miles of branch lines were run, making a total of 176 miles. The datum used was derived from the levels run from Edmonton to the east end of Lesser Slave lake in previous years. The lake is some seventy miles long, and the datum was transferred to Grouard at the west end by comparison of the gauges established by the Irrigation Branch. For this purpose the records of the daily readings for over a month were used. The mean elevation of the water at each end of the lake as deduced from these readings was assumed to be the same absolute elevation, and the relative elevations of the two zeros were thus found. The lines of levels running to the east and west ends of the lake were then connected to each zero, and the datum was in this way carried across the lake.

Miscellaneous lines of levels.

After completing the line of precise levels to Goodeve, Mr. Dozois levelled a line along the Canadian Northern railway between Swan River and Pelly, and along a travelled road from Pelly to the intersection of the Second meridian and the 9th base line. This was required in order to make a connection between Swan River and the point of commencement of the levels run westerly along the 9th base line, by Mr. A. G. Stuart, D.L.S., during the season. The connection is forty-three miles long, and was completed on September 15. From that date till November 30, he was engaged on reconnaissance levels in the district near St. Paul de Metis and Cold lake, during which time 168 miles of approximate levels were run.

Later on, in the early part of March, 1916, Mr. Dozois levelled a connection of eight miles from Mr. Christie's subdivision levels in tp. 54-23-2 to Candle lake. There was no known datum available for the subdivision levels, and it would have been too costly to level from Prince Albert. The elevation of Candle lake, however had been ascertained when the 15th base line was run in the year 1913, and this was considered sufficiently accurate to serve as a datum for the present. This connection occupied Mr. Dozois from February 27 to March 11 though the party was actually in the field only eight days. Considerable time was necessarily spent in getting from Calgary to the place and back again.

Another connection run to subdivision levels, for the purpose of supplying a known datum, was that levelled by E. W. Berry, D.L.S., from Mr. Lighthall's subdivision levels in tp. 63-7-5 to Westlock, a station on the Edmonton Dunvegan and British Columbia railway, about sixty miles north of Edmonton. This line was sixty-six miles along travelled roads, and took from December 9 to January 18.

The following table gives the lines of levels, of all classes, which were run in the twelve months ending March 31, 1916.—

Lines of levels run in season 1915.

Meridians and Base Lines.

Line.	Town- ships or Ranges.	Surveyor.	Miles.
8th base east of Principal meridian.....	7- 9	G. H. Blanchet.....	15
9th " " " "	6- 7	"	11
10th " " " "	4- 6	"	18
11th " west " "	10- 15	T. H. Plunkett.....	36
12th " " " "	11- 16	"	32
15th " " " "	4- 31	G. H. Herriot.....	164
East outline, range 3, east of Principal meridian.....	37	G. H. Blanchet. .	6
East " " 6, " "	33- 36	"	24
East " " 7, " "	29- 33	"	24
East " " 9, " "	27- 28	"	12
East " " 11, west "	41- 44	T. H. Plunkett.	24
East " " 13, " "	45- 48	"	24
East " " 21, " "	57- 60	G. H. Herriot.....	24
9th base, west of Second meridian	1- 29	A. G. Stuart.....	169
9th " " Third "	1- 29	"	169
9th " " Fourth "	1- 29	"	169
Fourth meridian.....	54- 61	"	48
27th base, west of Fourth meridian.....	1- 25	F. V. Seibert.....	145
East outline, range 9, west of Fourth meridian.....	103-105	"	10
Fifth meridian.....	15- 32	A. G. Stuart.....	108
24th base., west of Fifth meridian	1- 17	J. A. Fletcher.	102
25th " " " "	1- 17	"	102
27th " " " "	22- 25	J. R. Akins.....	16
Sixth meridian.....	91-126	"	216
30th base, west of Sixth meridian.....	1	"	3
Total.....			1,671

Subdivision of Townships.

Tp. 13-15-E; tp. 13-16-E; tp. 13-17-E, and tp. 14-15-E.....	W. A. Scott.....	92
Tp. 53-20-2; tps. 52 and 53-21-2, tps. 53 and 54-22-2; tp. 54-23-2, and tps. 53 and 54-24-2.....	W. Christie.....	260
Tp. 65-6-5; tps. 63, 64 and 65-7-5, and tps. 61 and 62-8-5.....	A. Lighthall.....	264
Tps. 82 and 87-19-5 and tp. 84-20-5.....	J. H. Johnston.....	238
Total.....		854

Precise Levels.

Line.	From	To	Route.	Surveyor.	Miles.
R	Portage la Prairie ..	Goodeve.....	Grand Trunk Pac. Ry	L. O. R. Dozois....	247
S	Saskatoon.....	Rosebud.....	Can. Northern Ry....	E. W. Berry.....	339
T	Grouard.....	Dunvegan.....	Wagon road.....	L. E. S. Bolton.....	144
		Total.....			730

Miscellaneous Levels.

Westlock.....	Tp. 63-7-5.....	Wagon road.....	E. W. Berry.....	66
Pelly.....	Swan River.....	Can. Northern Ry....	L. O. R. Dozois....	43
Miscellaneous short lines.....				72
Total.....				181
Total of all lines run during the year				3,436

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In addition to the above, reconnaissance levels were carried out in the district near St. Paul de Metis and Cold lake, Alberta, as follows: Desjarlais ferry to Cold lake, 118 miles; Charlotte lake to Saskatchewan river, 40 miles; Beaugard lake to Vincent lake, 10 miles. Total, 168 miles.

Work in the Calgary office.

In addition to the general work of supervision of the levels which have been run directly by the Calgary office, steady progress has been made in examining and compiling the results of the levels carried out during the year by all the surveyors employed by the branch. The latter amount to 1,671 miles of meridian and base line levels and 854 miles of subdivision levels, and the former to 911 miles (not including 168 miles of approximate exploratory levels). This makes a total of 3,436 miles of levels in one season. This is a large mileage of new work to be dealt with.

The general nature of the work is the same as was outlined in last year's report, with the addition of new arrangements for recording the subdivision levels. In the case of these no lists of bench-marks or of elevations are prepared. Two separate plans are made of each township. One of these shows only the bench-marks, giving their positions, descriptions and elevations. It is intended entirely as an office record. The second contains the elevations of the natural features which are plotted on the plan, line by line. The lines are then gone over, and the positions of the contours, generally for every ten feet, are marked by interpolation. The contours are then sketched in over the whole township, and the elevations of corners and of the more important features added to the plan. The subdivision levels taken during the past year involve twenty-five townships.

The following is a summary of the work done in the Calgary office during the twelve months ending March 31, 1916:—

	Meridian and Base Line Levels.	Precise Levels.	Subdivision Levels.	Other Levels.	Totals.
FIELD BOOKS.					
Received from the field, April 1, 1915 to March 31, 1916.....	118	61	38	9	226
Miles of levels recorded in these.....	2,550	837	743	242	4,372
Field books, entirely examined.....	102	42	25	0	178
Field books, partly examined.....	45	.....	.....	.....	45
BENCH-MARKS.					
Number of bench-marks compiled for the first time.....	3,582	515	333	.....	4,430
Number of miles in which they occur...	3,547	837	400	.....	4,784
PROFILES.					
Number of sheets completed.....	90	.....	8	tp. sheets	98
Number of miles on same.....	2,851	.....	400	.....	3,251

(To accompany report of J. N. Wallace, D.L.S.)

REPORT OF E. W. BERRY, D.L.S.

I beg to submit the following report on lines of levels run by me during the season of 1915. My first work was a line of precise levels from Saskatoon towards Calgary, along the Canadian Northern railway.

This work was begun at Saskatoon on May 20, and by August 11 we had proceeded as far as Alsask, and connected with four bench-marks established by Mr. A. G. Stuart D.L.S., when he was retracing the Fourth meridian in 1914. This involved running five miles of levels along the meridian and diverted road. From there the precise level line was continued to Rosebud, where work on the main line was suspended on October 19. The distance from Saskatoon to Rosebud is 339 miles. In addition to this, thirty-seven miles of spur lines to various bench-marks off the right of way of the railway were run during the season. The distance form Saskatoon to Calgary is nearly 400 miles.

On October 20 the camp outfit was consigned to Calgary. The party, with the exception of the recorder and two rodmen were paid off, and I returned to Hanna to connect the precise level line with the levels run by Mr. A. G. Stuart, D.L.S., along the 9th base line this season. The connection was made along the most frequented trail northerly from Hanna. The length of this connection is twelve miles. In addition one mile of levels was run along the base line, so as to connect with two of Mr. Stuart's bench-marks. Having completed this work I returned to Tessier on November 4. Here a similar connection was made to five bench-marks of the 9th base line in range 11, west of the Third meridian. This was accomplished by running south from Tessier station along the east boundary of section 1, township 33, range 11, to the base line, and west along the base line, a distance of three miles. This being completed, I paid off the remaining men and returned to Calgary on Novembr 5.

As usual, the precise level line was divided into sections about one mile in length. Every section was levelled at least once in each direction, and the mean of the determined values of the several differences of elevation was adopted in computing levels. The amount of the accumulated discrepancy between the forward and backward lines at intervals of ten miles, with the corresponding mileage, is tabulated below:—

Miles from Saskatoon.	Discrepancy (ft.)	Miles from Saskatoon.	Discrepancy (ft.)
0.....	—0.000	180.....	—0.054
10.....	—0.002	190.....	—0.083
20.....	—0.016	200.....	—0.034
30.....	—0.014	210.....	—0.022
40.....	—0.019	220.....	—0.036
50.....	—0.004	230.....	—0.028
60.....	—0.032	240.....	—0.027
70.....	—0.037	250.....	—0.031
80.....	—0.033	260.....	—0.042
90.....	—0.031	270.....	—0.066
100.....	—0.063	280.....	—0.046
110.....	—0.075	290.....	—0.041
120.....	—0.129	300.....	—0.051
130.....	—0.063	310.....	—0.007
140.....	—0.067	320.....	—0.058
150.....	—0.069	330.....	—0.050
160.....	—0.046	339.....	—0.013
170.....	—0.078		

Permanent bench-marks on concrete pillars were erected at uniform distances of four miles apart as nearly as possible. The pillars are in the form of a frustum of a pyramid, twelve inches square in horizontal cross-section at the base, and eight inches

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at the top. They are six feet in height, and rest on a concrete foundation five feet below the surface of the ground. The bench-mark point is on a brass plate sunk in the top of the pillar. No pillar was placed within a mile of any railway station. When pillars are placed near to stations there is danger of their being disturbed when buildings are erected later. Additional bench-marks on copper bolts were placed on suitable masonry structures where these occurred. The work of making bench-marks was done by two men who travelled in advance of the party. Bench-marks were completed along the whole line from Saskatoon to Calgary. Between Saskatoon and Rosebud there are one hundred and forty permanent bench-marks. Of these, fifty-three are copper bolts in the masonry of buildings or bridges and eighty-seven are brass-plates on the standard concrete pillars. Between Rosebud and Calgary there are twenty bench-marks on masonry structures and fifteen on concrete pillars. In all one hundred and seventy-five bench-marks were made during the season.

The elevations of the railway grade opposite all railway stations were recorded, also of the top of rail at the crossing of all roads of the Dominion Lands system of survey between Saskatoon and Red Deer river, with the exception of a few roads which have been closed for some reason. West of Red Deer river the land is hilly and broken by numerous ravines. East of Rosebud, very few roads have been opened across the railway, as the land which belonged to the Canadian Pacific Railway company has been resurveyed into blocks of irregular shape following the contours of the ground. Eighty-three elevations of water level in lakes and streams along the line were also obtained.

The elevation of the base of rail opposite the Canadian Northern railway station at Saskatoon is 1,590 feet above mean sea-level. Rosetown with an elevation of 1,926 feet is 336 feet higher. It is seventy-one miles distant from Saskatoon along the railway. Leaving Rosetown the ascent of Bad hills commences, and the summit is reached at D'Arcy at an elevation of 2,285 feet. This is 360 feet above Rosetown and twenty-six miles west of the latter place. From here to Kindersley where the elevation is 2,231 feet, there is a gradual descent of fifty-four feet. Westerly from Kindersley, the railway rises gradually, crossing some minor summits and depressions to Hanna. The elevation of Hanna is 2,679 feet or 448 feet above Kindersley. From Hanna the line follows the valley of Bullpound creek to its headwaters near Delia in Hand hills. The base of rail at Delia station is 294 feet above Hanna and 2,973 feet above mean sea-level. This is the highest railway station between Saskatoon and Red Deer river. The first water draining southwest to Red Deer river is Mecheche creek. The descent from Delia to the water of Red Deer river is 744 feet in a distance of twenty-eight miles. The elevation of this river is 2,229 feet. After crossing Red Deer river, the railway follows its course to the confluence of Rosebud river at Rose-dale, four miles southeast of Drumheller. Thence it ascends the valley of Rosebud river. The rise from Red Deer river to Rosebud station is 356 feet in a distance of twenty-five miles. The elevation of the railway grade at Rosebud is 2,585 feet.

There were an exceptional number of rainy days during the early part of the season. Apart from this, the weather conditions were about normal. The chief difficulties with which we had to contend were the unsteadiness of the atmosphere and the almost incessant high winds which are familiar to every one who has done precise instrument work in the prairie provinces.

From November 5 to December 8 I was engaged in preparing the returns of the precise level line from Saskatoon to Rosebud and on other office work. My next work was a line of levels to provide a datum for the levels run during 1915 by Mr. A. Light-hall, D.L.S., in subdividing townships 61 and 62, range 8, townships 63, 64 and 65, range 7, and township 65, range 6, all west of the Fifth meridian.

This line was commenced at the SE. cor. sec. 3, tp. 63-7-5. From there the levels were carried down Freeman river for several miles, then along a Provincial Government road to the E. By. sec. 28, tp. 60-4-5, and thence along section road allowances to

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Westlock, where we connected with the Edmonton Dunvegan and British Columbia railway. The length of this line is sixty-six miles. The work was commenced on December 18, and was completed on January 17.

The degree of precision required for this work was the same as for levels on base lines, viz. 0.10 feet discrepancy per mile section. The line was divided into sections about one mile in length and each section was levelled forward and checked in the opposite direction. Each section begins and ends on a bench-mark. These were spikes in growing trees or in telephone poles. Seventy-two bench-marks were established in all. The elevation of the ground at corner monuments and other points which can be identified on the ground and published on the map, were determined in connection with the work. Of these there are eighty-five. The water level of streams and rivers was also taken at thirteen definite points. In addition to furnishing a datum for the levels of Mr. Lighthall's surveys, this line affords a good line of levels, believed to be of sufficient accuracy for any practical purpose except the extension of the precise level network. It runs through a district already almost completely occupied by settlers, and in which engineering problems in connection with highways, railways, and drainage will have to be solved at no very distant date.

Freemen river is a small and rapid stream in a narrow valley whose rim is one hundred feet above the water. At some places along the course of the river the ground rises in tiers of benches, and the edge of the valley is over a mile from the river; at others, a cut bank rises sheer from the water's edge. The elevation of the water of Freemen river at the south boundary of township 63, range 7, is 2,270 feet above mean sea-level. Two miles south and about one and a half miles east of this point, the river crosses the north boundary of section 24, township 62. Here its elevation is 2,200 feet. This gives a fall of seventy feet in a distance of about three and a half miles along the winding course of the river. The elevation of Athabaska river at Holmes Crossing is 1,968 feet. On the south side of Athabaska river, there is a flat about three-quarters of a mile wide. The road follows this for four miles, and then commences the steep ascent from Athabaska valley. The highest point is reached near the intersection of the road with the east boundary of section 23, township 61, range 5, where the elevation is 2,319 feet, being 351 feet above the water level of Athabaska river. At the end of the provincial road in section 28, township 60, the elevation is 2,201 feet. Opposite the Lutheran church near the northeast corner of section 16, township 60, range 3, there is a minor summit of 2,290 feet. At Barrhead post office the elevation is 2,222 feet. The water level of Pembina river at Rossington ferry is 2,029. This is sixty-one feet higher than Athabaska river at Holmes Crossing. The grade of the Edmonton Dunvegan and British Columbia railway at Westlock station is 2,127 feet above mean sea-level.

The weather was comparatively mild until Christmas, but after that the cold became severe, the temperature ranging from 0° to -50°. There were, however, no heavy snowstorms, so that the work proceeded without interruption. The work was finished at Westlock on January 18.

(To accompany report of J. N. Wallace, D.L.S.)

REPORT OF L. E. S. BOLTON, D.L.S.

Line of levels from Grouard to Peace River and Dunvegan.

Previous to this season a line of levels had been run from Edmonton to Athabaska and thence up Athabaska and Lesser Slave rivers to the water of Lesser Slave lake. My work this season consisted in continuing this line of levels farther west. The water of Lesser Slave lake was utilized to transfer the elevation from the east end of the lake at Sawridge to the west end at Grouard. This was done by reference to the readings of the gauges placed at each end of the lake by the Commissioner of Irrigation.

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The line of levels from Grouard to Peace River Crossing was commenced on June 23, along the travelled highway. This road runs across clay land which is never dry, except on the surface, and this caused difficulty in getting stable turning points. The first fifty miles, to the junction of the trail from Reno, had been travelled very little this year so that it was not much cut up but it is the wettest portion of the trail, and there progress was slow. The deep mud made walking difficult and there was some rainy weather which kept the road wet, although it caused us to stay in camp for only two and a half days. After passing the junction of the trail from Reno, there was no wet weather.

Only one rodman was employed. Using two rodmen would have eliminated the error due to the settling of the instrument, but on a road with as hard a surface as this, except after a rainy spell, the error caused by the settling of the instrument is much smaller than that caused by the settling of the hub. The best turning point was obtained by driving the hub into a corduroy log which was entirely beneath the surface of the road. From Peace River Crossing to Dunvegan the bed of the road contains a larger percentage of sand and gravel and in this portion very little difficulty was experienced from sinking of the hubs. On the contrary, the hub, when driven firmly into the ground in the sand and gravel road, frequently rose up, so that it was found better to place them off the trail altogether. The traffic here did not interfere with the work, as we did not follow the surveyed trail but the road to the south which follows section lines and will eventually be the travelled road.

It was difficult to avoid inequality in the lengths of the back-sights and fore-sights. It is not possible to keep these individually equal unless a great deal more time be taken. The only thing that can be done is to arrange that the accumulated lengths shall be equal over each division.

The permanent bench-marks established consisted of iron pipes four feet long and two and a half inches in diameter, with a plate seven inches in diameter screwed to the foot. On the top end a brass cap is riveted on which is marked "TOPOGRAPHICAL SURVEYS, LEVELS, B.M." and the number. These were planted every four miles, on section lines wherever possible, and back from the road where they would be least likely to be moved by grading outfits or by settlers when ploughing their land. The only other permanent bench-mark established was one copper plug. This was placed in the sandstone cliff at Peace River Crossing on the west side of the river.

To make the connections across Lesser Slave lake I utilized the gauges established by the Commissioner of Irrigation at Grouard and at Sawridge. For this purpose the mean of the readings from September 1 to October 15, at each gauge was taken. The mean of each gauge would give the mean elevation at that end of the lake, during a time which included both east and west storms and normal conditions. It is therefore reasonable to assume that the mean at one end is the same absolute elevation as the mean at the other end. At Grouard the rod was held directly on the eight-foot mark on the gauge, so that the zero of the gauge was obtained directly. At Sawridge the work was a little more complicated, as the gauge is on Dog island, about two miles out in the lake. A temporary gauge was placed in the lake behind a small point of land half a mile from the source of Lesser Slave river so as to be away from any local effect due to the lake emptying into the river. An arrangement was then made with the observer of the gauge at Dog island whereby he read the gauge in the evening when the lake was most nearly calm, and fired two shots as a signal at the time. I then read the temporary gauge. As the rise and fall of the water at the temporary gauge was only 0.05 feet at the time of reading, the result is more accurate than would have been gained by attempting to take a sight with the level across the two miles of water.

The allowable closing error was $0.017 \sqrt{\text{distance in miles}}$. It was necessary to do a considerable amount of rerunning to get the levels to check within this limit and, as the ground was very soft, the hub was always sinking so that the error was accumulative. At the end of sixty miles, the total discrepancy was -0.178 feet, which

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is equivalent to an error of 0.023 feet $\sqrt{\text{distance in miles}}$, and at ninety miles it was -0.234 feet, which is equivalent to an error of 0.024 feet $\sqrt{\text{distance in miles}}$. The closing errors then became positive and the total discrepancy decreased. To avoid so much rerunning it was considered advisable to increase the allowable error to 0.030 feet for an individual mile section. This resulted in much less rerunning. When the line reached Dunvegan, at the end of 144 miles, the total discrepancy was -0.109 feet which is equivalent to an error of 0.009 feet $\sqrt{\text{distance in miles}}$.

When crossing the 21st base line on the road from Grouard to Peace River Crossing, a connection was made with the bench-mark established by Mr. A. H. Hawkins, D.L.S., during the season 1910. This bench-mark was two miles from the trail, and it was necessary to employ the teamster to open up the line.

Connection was also made with the bench-mark established by Mr. J. H. Johnston, D.L.S., from which he ran levels northerly to the 22nd base line in connection with the levels of his subdivision work.

A spur line was run to lake Cardinal. There was no available trail, but the country was fairly open, so that no difficulty was experienced in making the connection. When crossing the Sixth meridian, two permanent bench-marks were established. After completing the line to Dunvegan we came back and started from these bench-marks to go up the Sixth meridian, to the bench-mark established by Mr. J. R. Akins, D.L.S., during the season of 1912, at the southerly end of the meridian levels in township 84. As the line was filled with second-growth willow and poplar, I went east to the trail leading to Last lake and used it. This made the distance twenty-four miles. From Last lake the line had been partly opened up by Mr. R. V. Heathcott, D.L.S., during the present season. The remainder, some four miles, I had to have cut out. For this purpose I engaged a man in the vicinity.

The elevations of all streams, and of the ground at the crossings of all section lines, were recorded. When crossing a section line the elevation of the ground was taken at a section or quarter-section post unless the post was some distance from the trail, in which case the elevation of the centre of the road was taken.

From Grouard to Peace River Crossing the country was generally rolling with a few hills near the summit of the divide. West of Peace River Crossing the country is undulating with no pronounced hills.

From Grouard around Buffalo bay the trail goes through a low flat for twelve miles, and then rises 400 feet in the next four miles. The elevation in section 6, township 77, range 15, is 2,336 feet. This is the summit of the divide between Lesser Slave lake and South Heart river. The elevation at South Heart river, twenty-three miles from Grouard, is 2,046 feet. The line then rises for nine miles until, in section 32, township 78, range 17, the elevation is 2,300 feet. It then falls to Bearhead creek in section 25, township 79, range 18, which has an elevation of 2,181 feet. This is thirty-eight miles from Grouard or halfway to Peace River Crossing. From Bearhead creek it rises for six miles, until in section 15, township 80, range 18, the elevation is 2,314 feet, and then falls to an elevation of 1,922 feet at North Heart river, which is fifty-six miles from Grouard. It then falls about thirty feet to the mile until the top of Peace river valley is reached. The east bank of the valley is about 700 feet above the river, the elevations of the top of the valley and of the water of the river being 1,720 feet and 1,025 feet, respectively.

After crossing the river the trail runs for twenty miles along the western side, keeping in the low land, about fifty feet above the river. Hence it is nearly level, except for three hills one hundred feet high where the trail goes up and around a cut bank. Where the trail leaves the river the bank is 800 feet high. The elevation at the top is 1,849 feet. Then the country is nearly level, rising only about twenty feet per mile to a point three miles west of the Sixth meridian where the elevation is 2,183 feet. From there north the country is nearly level. Lake Cardinal, six miles north, has an elevation of 2,124 feet.

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From there the country falls steadily to the top of the hill at Dunvegan, the elevation of which is 1,767 feet. The elevation of the water in Peace river is 1,091 feet, which is sixty-six feet higher than at the town of Peace River Crossing.

In making the connection with the levels on the Sixth meridian the trail goes through level country as far as Last lake, which has an elevation of 2,132 feet. From Last lake, going north, the meridian passes over rising ground reaching an elevation of 2,171 feet at the north of township 84, where I connected my levels to the levels previously run north from that point.

In all 176 miles of levels were run as follows:—

	Miles.
From Grouard to Dunvegan	144
To connect with 21st base line	2
To connect with lake Cardinal.....	6
To connect with Sixth meridian	24
Total	176

Work was begun at Grouard on June 23 and finished on September 24. The party arrived at Edmonton on October 1. After arranging for storage at Edmonton, I went back to Sawridge and connected the bench-marks there with the water-gauge as previously explained. I returned to Calgary on October 8.

(To Accompany Report of J. N. Wallace, D.L.S.)

REPORT OF L. O. R. DOZOIS, D.L.S.

From April 30 to May 8, I was engaged in retracing a portion of the precise level line run the previous season from Winnipeg to Swan River. The line was releveled from the initial bench-mark on Fort Garry Union station to bench-mark 4, on the railway near the limits of the city. A spur line was also run from Fort Garry Union station to the Canadian Pacific Railway station at St. Boniface; a connection with their datum at this point was desired for purposes of comparison between our levels and railway levels.

In doing this work it was necessary, in places, to follow the main streets, and so the work had to be done in the early morning before the daily traffic had begun.

The party was composed of a recorder, two rodmen, an umbrella man, a cook, and a hand-car pilot, the latter being appointed by the Grand Trunk Pacific Railway Co., while his wages were to be paid by us.

The levels along the track of the Grand Trunk Pacific railway westerly from Portage la Prairie were begun on May 10. The datum used was derived from the two bench-marks established the previous year on the armoury and court house respectively. These elevations had been listed on the latest revised sea-level datum.

For the first 125 miles, as far as Miniota, the wind was a serious drawback to the progress of the work. This was particularly the case while working through the flat table-land known as the Portage plains. This wind-swept territory may be said to extend about sixty miles west of Portage la Prairie.

During the early part of May, just following seed-time, the sandy soil is lifted by the wind and formed into clouds which fill the atmosphere with dust. On one occasion the wind was sufficiently strong to force a freight car out on the main line by springing the switch, and to then drive it a couple of miles down the track. Beyond Portage plains as far as Miniota the country becomes more rolling, with occasional wooded bluffs, which afford some respite from the wind.

At Miniota the railroad descends into a valley of Assiniboine river, through which it winds for twenty-five miles as far as Lazare. Qu'Appelle river joins with

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the Assiniboine just west of Lazare station. The railway crosses the Assiniboine there, and entering Qu'Appelle valley, it ascends sharply for twelve miles, returning to the uplands at Welby station, near the Saskatchewan-Manitoba boundary.

Along the forty miles of track that lie in the Assiniboine and Qu'Appelle river valleys the levelling proceeded much more satisfactorily, due to the complete absence of wind. By this time, however, the July heat had arrived and the radiation of heat from the earth's surface was having a disturbing effect on the accuracy of the readings. The result was shown in more cases of third levelling being required, and a correspondingly fewer number of small closings for a mile section.

It became apparent at this stage of the season that really good levelling conditions would never occur so long as work was carried on during the three or four hours preceding and following mid-day. On a hot day in July or August, with a clear sky, the air begins to wave at about 8.30 a.m., and gradually becomes more disturbed until noon, when the rod cannot even be read to the nearest hundredth of a yard with any confidence. It remains in this disturbed condition until about 3.30 p.m., when it begins to subside, and has usually returned to a tranquil state at about 5 p.m.

It has been found that a light wind has a modifying influence on "shaky" air, and for this reason the state of the air will vary from day to day. Generally speaking, however, I am of the opinion that precise levelling cannot be efficiently carried on in the prairie provinces during, approximately, eight hours of the day, four hours in the forenoon and four hours in the afternoon. This statement does not apply to cloudy days, providing the weather is not sultry.

The only remedy that presented itself was a complete change in the working schedule. Heretofore the daily working hours had been from 7 a.m. until 6 p.m. It was decided to utilize the hours following sunrise and preceding sunset, and accordingly, on July 7, the new schedule was put into effect. We were at this time in the Assiniboine valley. Work was started at 5 a.m. and continued as long as the air remained steady. As soon as the air showed signs of "shakiness" work was adjourned and the party returned to camp. This hour would necessarily vary with the month of the year. In July the air will first show signs of unsteadiness, when the sky is clear, between 8.00 and 8.30 a.m. At about 4.30 p.m. we were back at our posts, the instrument set up and the rodman in position, ready to begin work when the air permitted. The state of the air was observed every five minutes, and when it had sufficiently subsided, work was resumed. The hour at which the air will return to its normal state could not be determined definitely as this hour was observed to vary greatly, being influenced by the temperature, moisture, wind, etc. On some clear days we were able to resume work at 4.30 p.m., while on others the air would be unsteady until 6.30 p.m. Work would be stopped between 8 and 9 p.m.

When the sun is low, as it was under this new time schedule, there is a pronounced difference in illumination of the forward and backward rods when running parallel with the rays of the sun. This might give rise to an accumulative error, though hidden, if not counteracted by a proper adjustment of the field work. The only safe way is to leave the early morning work to be checked in the opposite direction in the evening. In this way any small error of illumination is bound to appear when the forward and backward values are compared. The mean of the two values will be unaffected by the error. Local mean time should be used instead of standard time.

The new schedule showed such a marked improvement that it remained in force until the end of the season. The hours had to be adjusted as the summer wore on. The impression should not be gathered that the new schedule was less strenuous on the members of the party than the old one, although the day's work was only five and sometimes six hours long instead of ten hours. The new schedule had not been in force two weeks before any member of the party would gladly have returned to the ten hour day. This was notably so in the case of the cook, who was required to serve breakfast at 4.30 a.m. and dinner at 9 and 9.30 p.m. However, the change of schedule

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was a success considering the results attained. The bad effects of the disturbed air were not only avoided, but the evil influences of the wind were no longer a daily occurrence.

The daily action of the wind on the prairie may be described as very similar to the heat waves, that is to say, it comes on gradually, first as a breeze shortly after sunrise, and grows in volume as the sun gets higher. Almost invariably, the wind will abate a little before sunset and drop entirely as the sun goes down..

From Portage la Prairie the railway rises steadily from an elevation of 858 feet to an altitude of 1,647 feet at Oakner, 100 miles farther west. From there to the beginning of the descent into the Assiniboine valley the grade shows a drop of 150 feet in twenty miles, and in the next fourteen miles it drops 220 feet to the bottom of the valley, resulting in an elevation of 1,277 feet for Treat station. The railway crosses Assiniboine river at a grade level of 1,302 feet, and rises 300 feet in the next twelve miles, attaining an altitude of 1,602 feet at Welby station. From Welby to Goodeve, which is as far west as the levels were carried, there is a constant rise, an altitude of 2,102 feet being reached at Goodeve.

For the first twenty miles the accumulated discrepancy between the forward and backward lines fluctuated on either side of the zero mark, that is to say, it was positive for a couple of miles, then negative and vice versa. After twenty miles it became negative and remained so for 225 miles to the end of the season, when it had amounted to 0.079 feet. The greatest accumulated discrepancy was 0.141 feet at mile 225 from the beginning.

In all, 267 sections were run, the average length of a section being 0.9 miles. Of these only twenty-seven sections have a discrepancy exceeding 0.010 feet. This amounts to ten per cent, as compared with twenty-five per cent on last season's work. The positive and negative discrepancies were about equal in number. The probable error of the mean of a mile section is 0.002 feet, and the probable error of the whole line of 247 miles is 0.0345 feet.

The only streams of any note crossed by the Grand Trunk Pacific railway, from Portage la Prairie westerly, are Minnedosa, Oak, Arrow, Assiniboine, and Cutarm rivers. Besides these there are five or six creeks, some of which are dry in summer. The elevation of the water was recorded in all streams crossed by the line of levels.

From Gerald to Goodeve, a distance of sixty-seven miles, there is a serious scarcity of water in the immediate vicinity of the railway. There were no lakes on either side of the railway of sufficient importance to justify the running of branch lines of levels.

Along this line of levels fifty-nine permanent bench-marks were established. These may be classified as follows in the order of their value as to permanency: concrete pillars, twenty-nine; bridge piers, two; churches and schools, five; water tanks, seven; elevators, five; dwelling houses, seven; hotels, one; railway semaphore stands, one; stations, one. A permanent record of the elevations was thus left on the ground at intervals averaging 4.2 miles. Apart from these, 232 temporary bench-marks were established by spikes driven horizontally into telegraph poles.

Tests carried out on other lines, by this office, have shown that there are comparatively few cases where these temporary bench-marks become disturbed by more than a tenth of a foot in a couple of years.

A connection was made with the line of levels run by Mr. A. G. Stuart, D.L.S., along the east boundary of range 31, west of the Principal meridian. The connection was made by means of a spur line from about midway between Welby and Spyhill stations. Two of Mr. Stuart's bench-marks established at the westerly end of the 6th base were also tied in with the precise level line by a spur run northerly along the Second meridian from the railway.

These two connections were about twenty-eight miles apart reckoned along the route followed by Mr. Stuart's levels. His levels for this distance agree very closely

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with our precise levels along the railway, the disagreement being only 0.02 feet in the twenty-eight miles.

A connection was also made with the level datum of Melville, Sask. Work was discontinued on August 28, a total distance of 247 miles having been levelled in the period from May 8 to August 28. This is an average rate of $67\frac{1}{3}$ miles per month. Work was stopped at this early date, as it was desired that I should run a line from Pelly to Swan river over the Canadian Northern railway, for the purpose of connecting Mr. Stuart's levels on the 9th base to the main line of precise levels from Winnipeg to Edmonton.

These levels were begun at the eastern extremity of the 9th base and carried $4\frac{1}{2}$ miles north along the Second meridian to the railway. The meridian crosses this branch of the Canadian Northern railway (known as the Thunderhill branch) at a point four miles west of Pelly station. The elevation of the Second meridian at the crossing is 1,454.1 feet, while sixty miles farther south, where it crosses the Grand Trunk Pacific railway, the elevation is 1,717 feet.

It was not intended that this line should be run with the usual precision governing levels along the railway. The primary object, in this case, was to obtain a comparison of datums between the levels run on the 9th base and those along the railway through Swan River. To avoid any third levelling the allowable closing per mile section was increased to 0.30 feet. Permanent bench-marks were established wherever suitable structures were available. No concrete pillars were made on this line. The total distance levelled was forty-three miles. This was completed in the period from September 2 to the 14th. Three permanent bench-marks were established as well as thirty-nine temporary bench-marks. The elevations of eight streams and of the base of rail at five railway stations were recorded. Road crossings were also recorded at about every two miles.

The party was disbanded on September 15, and I left for Calgary the same day, arriving there on the morning of the 20th, being delayed one day at Melville in connection with the storage of my outfit.

From September 30 to November 30, I was engaged in running approximate lines of levels through the country covered by the Saddle Lake sectional map. This is a district near St. Paul de Metis and Cold lake, Alberta. A total of 168 miles were levelled and the elevations of thirty-six lakes, twelve streams and one hundred and two land points were recorded. On my return to Calgary I was engaged in making up part of my returns till December 15, when I went east, returning to Calgary on February 15, 1916.

I left Calgary for Prince Albert on February 27 in order to run a connection between Candle lake and Mr. Christie's subdivision levels. The levels were begun from Candle lake and carried across Torch lake, and then southerly to the subdivision, following a very winding bush trail about eight miles in length. This work was completed on the evening of March 9. A double line was run.

The snow was still over two feet deep in the bush and the temperature well below freezing except near midday when it was comparatively mild and springlike.

The return trip to Prince Albert was completed at noon March 10, and I left at once for Calgary, arriving there on the afternoon of the 11th.

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APPENDIX No. 71.

ABSTRACT OF THE REPORT OF W. E. WELD, D.L.S.,

SUBDIVISION SURVEYS NEAR GRAND RAPIDS, MANITOBA.

We reached Grand Rapids on September 3, and began the season's work by subdividing tp. 48-13-Pr. After finishing work in the eastern part we moved across the township on the Hudson's Bay Company's tramway.

It is narrow gauge with a very light iron rail, and save as a convenience for the few travellers, it is little used, and is falling into disrepair. The company owns a large lot at the east end of the tramway and another of about nine acres in extent at the west end. On the latter are the remains of a large frame freight shed, into which the tramway runs, a large log residence, and a frame warehouse. About one-half mile down stream from this lot, there is another Hudson's Bay company's lot about forty acres in area.

From the up-stream end of the portage the subdivision was continued.

The cutting was heavy almost throughout, the slowest progress being made through the dense second growth of jack pine which grew through the tangled mass of fire-killed trees lying around in certain sections. On leaving the muskeg adjoining the settlement and travelling west, one does not meet with any water whatever in the township or in the tier of sections of the township adjoining, and this lack of water will be a great handicap and will retard settlement in the township.

On September 24, the subdivision being almost completed, work was commenced on the river traverse. The low banks and willow found in places, rendered it impracticable to adopt the stadia method, and owing to the current short distances only could be chained across the water, particularly in the rapids where it was not safe to let the chain enter the water; on account of this the courses had to be cut out and were necessarily short. Much greater care than is usually adopted in such traverses was taken, owing to the great water-power possibilities, and all the information possible regarding the banks was obtained.

Camp was moved back across the tramway on September 30, and the remainder of the week devoted to retracing the Indian Reserve boundary and continuing the river traverse. On October 4, the survey of the additional lots at the settlement of Grand Rapids was commenced. This work, together with the completing of the traverse of the Indian reserve and river, the traverse of the bay and overflow channel, the road across the Hudson's Bay company's lot, and mounding and marking posts, kept the entire party busy.

Fortunately everything was completed on October 16, just giving time to strike camp and embark on the steamer "Wolverine" which left Grand Rapids for Selkirk on the following day. Winnipeg was reached on the 19th and the final work of the survey completed there on the 21st.

The soil in tp. 48-13-Pr. varies considerably, sections 13, 14, 15, 27, and 34 being largely spruce muskeg, dry on the surface and wet underneath. In some cases, it was found to be frozen solid a foot or so beneath the surface. Elsewhere, under a varying thickness of loam mixed with humus we found clay, mixed sometimes with sand or gravel, and usually interspersed with limestone boulders of varying size. A layer of stone an inch or two thick was frequently found above the clay. In general, the soil is not promising from an agricultural aspect, although sufficient crops for local consumption could be raised. Summer frosts too are of frequent occurrence.

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This township has suffered severely from fires, particularly along the tramway and the river, and except for occasional patches of good spruce, tamarack and jack pine, the township is in the main covered with a dense second growth of no commercial value. In the four sections surveyed in tp. 48-14-Pr. some very good stands of jack pine and spruce up to twelve or eighteen inches in diameter were found, and there are indications that this extends farther into that township.

As has already been pointed out, the lack of water would prove a serious hindrance to the development of the district. The development of the water-power or the extension of the railway from Gypsumville would undoubtedly help the district, but both of these are somewhat improbable at the present, and no great stride in the development of Grand Rapids can be expected in the immediate future.

The weather was in the main good, with heavy frosts and several snowfalls throughout September. The black flies, however, remained in great numbers until the close of the survey.

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APPENDIX No. 72.

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.

Table 1.—Declination Observations.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
21.84 E.-NE. cor. sec. 32.....	88	1	E. 2 E.	Dec. 24, '14	9 22	G. H. Herriot.
0.60 E.-" 33.....	88	1	"	" 26, '14	08	"
58.03 E.-" 35.....	92	2	"	" 19, '14	6 39	B. W. Waugh.
58.03 E.-" 35.....	92	2	"	" 19, '14	38	"
34.75 E.-" 32.....	88	4	"	Jan. 12, '15	58	G. H. Herriot.
22.52 E.-" 33.....	88	4	"	" 13, '15	18	"
39.07 E.-NW. " 31.....	88	5	"	" 15, '15	7 37	"
33.71 E.-NE. " 31.....	88	5	"	" 16, '15	8 02	"
56.26 E.-" 33.....	88	5	"	" 18, '15	01	"
6.31 E.-" 34.....	88	5	"	" 19, '15	05	"
6.90 E.-" 33.....	92	6	"	" 5, '15	6 09	B. W. Waugh.
6.90 E.-" 33.....	92	6	"	" 5, '15	11	"
28.25 E.-" 32.....	88	8	"	Feb. 1, '15	25	G. H. Herriot.
28.25 E.-" 32.....	88	8	"	" 1, '15	25	"
28.25 E.-" 32.....	88	8	"	" 1, '15	25	"
62.68 E.-" 33.....	88	8	"	" 2, '15	4 46	"
62.68 E.-" 33.....	88	8	"	" 2, '15	46	"
44.79 E.-" 34.....	88	8	"	" 3, '15	5 18	"
44.79 E.-" 34.....	88	8	"	" 3, '15	17	"
6.95 E.-NW. " 31.....	88	9	"	" 5, '15	40	"
34.20 E.-NE. " 31.....	88	9	"	" 6, '15	23	"
22.54 E.-" 32.....	88	9	"	" 8, '15	31	"
22.54 E.-" 32.....	88	9	"	" 8, '15	23	"
65.00 E.-" 33.....	88	9	"	" 9, '15	6 04	"
65.00 E.-" 33.....	88	9	"	" 9, '15	5 58	"
28.26 E.-" 33.....	88	10	"	" 13, '15	5 24	"
28.26 E.-" 33.....	88	10	"	" 13, '15	19	"
1.28 S.-" 1.....	91	11	"	Mar. 11, '15	4 47	"
1.28 S.-" 1.....	91	11	"	" 11, '15	47	"
B.M. S.-" 36.....	37	3	E. Pr.	May 18, '15	12 17	G. H. Blanchet.
55.6 S.-" 13.....	37	3	"	" 22, '15	15	"
21.86 E.-" 31.....	72	3	"	July 10, '14	16 42	G. H. Herriot.
21.86 E.-" 31.....	72	3	"	" 10, '14	39	"
42.00 E.-" 32.....	72	3	"	" 13, '14	21 39	"
42.00 E.-" 32.....	72	3	"	" 13, '14	35	"
37.35 E.-" 35.....	72	3	"	" 14, '14	15 28	"
37.35 E.-" 35.....	72	3	"	" 14, '14	31	"
47.00 E.-" 31.....	36	4	"	May 26, '15	12 55	G. H. Blanchet.
34.67 E.-NW. " 31.....	72	4	"	July 15, '14	15 44	G. H. Herriot.
34.67 E.-" 31.....	72	4	"	" 15, '14	49	"
49.35 E.-NE. " 32.....	72	4	"	" 17, '14	10	"
49.35 E.-" 32.....	72	4	"	" 17, '14	18	"
42.91 E.-" 34.....	72	4	"	" 20, '14	16 36	"
42.91 E.-" 34.....	72	4	"	" 20, '14	40	"
At " 35.....	25	5	"	Mar. 12, '15	11 34	W. J. Deans.
At " 35.....	25	5	"	" 13, '15	12 06	"
27.00 W.-" 33.....	28	5	"	July 30, '15	12	R. B. McKay.
54.00 E.-" 34.....	36	5	"	June 5, '15	11 48	G. H. Blanchet.
58.90 E.-" 33.....	72	5	"	July 27, '14	15 26	G. H. Herriot.
58.90 E.-" 33.....	72	5	"	" 27, '14	29	"
8.00 E.-" 36.....	32	6	"	" 13, '15	11 11	G. H. Blanchet.
73.00 S.-" 36.....	33	6	"	" 2, '15	18	"
73.00 S.-" 13.....	33	6	"	" 5, '15	12 21	"
65.00 S.-" 36.....	34	6	"	June 26, '15	01	"
9.00 S.-" 36.....	35	6	"	" 21, '15	11 52	"
38.00 E.-" 31.....	36	6	"	" 8, '15	32	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
35.00 E.- NE. cor.sec. 34.....	36	6	E. Pr.	June 11, '15	11 15	G. H. Blanchet.
48.00 S.- " 36.....	36	6	"	" 14, '15	10 35	"
At " 36.....	16	7	"	" 27, '15	12 37	R. B. McKay.
At $\frac{1}{4}$ sec. cor. E. by sec. 36.....	16	7	"	" 28, '15	37	"
At NE. " sec 36.....	16	7	"	July 6, '15	24	"
78.00 S.- " 13.....	30	7	"	" 31, '15	11 59	G. H. Blanchet.
63.00 S.- " 24.....	31	7	"	" 26, '15	42	"
3.80 W.- " 34.....	12	9	"	May 4, '15	56	C. F. Aylsworth.
20.00 N.- $\frac{1}{4}$ sec. cor- E by sec. 30.....	21	9	"	Oct. 12, '14	21	W. J. Deans.
20.00 N.- " 30.....	21	9	"	" 13, '14	12	"
20.00 N.- " 30.....	21	9	"	" 15, '14	09	"
40.00 S.-NE. cor. sec. 4.....	25	9	"	" 17, '14	21	"
0.46 N.- " 36.....	25	9	"	Aug. 16, '15	16	R. B. McKay.
60.00 S.- " 36.....	27	9	"	" 27, '15	12 04	G. H. Blanchet.
63.00 S.- " 25.....	27	9	"	" 28, '15	11 07	"
44.00 S.- " 13.....	27	9	"	" 30, '15	10 50	"
40.00 S.- " 10.....	4	10	"	June 6, '15	58	C. M. Walker.
At " 31.....	12	10	"	May 10, '15	13 14	C. F. Aylsworth.
41.00 E.- " 33.....	12	10	"	" 11, '15	11 45	"
15.50 S.- " 32.....	12	10	"	" 12, '15	18	"
31.00 S.- " 28.....	12	10	"	" 13, '15	9 57	"
22.50 N.- " 21.....	12	10	"	" 14, '15	10 45	"
11.00 W.- " 29.....	12	10	"	" 15, '15	11 33	"
15.00 S.- " 34.....	12	10	"	" 17, '15	11 06	"
26.00 W.- " 21.....	12	10	"	" 18, '15	10 03	"
6.70 W.- " 16.....	12	10	"	" 19, '15	9 02	"
63.70 N.- " 2.....	12	10	"	" 21, '15	10 21	"
69.75 E.-NW. " 31.....	80	10	"	July 4, '14	11 37	B. W. Waugh.
21.33 E.-NE. " 33.....	80	10	"	" 9, '14	10 28	"
21.24 E.-NW. " 31.....	80	11	"	" 13, '14	12 49	"
47.27 N.-NE. " 13.....	81	11	"	" 23, '14	11 45	"
56.68 N.-NE. " 13.....	82	11	"	" 31, '14	18 38	"
73.75 N.-NE. " 25.....	82	11	"	Aug. 1, '14	13 45	"
73.75 N.-NE. " 25.....	82	11	"	" 2, '14	40	"
30.28 N.-SE. " 1.....	83	11	"	" 4, '14	15 31	"
64.46 N.-NE. " 12.....	83	11	"	" 7, '14	14 11	"
30.12 N.- " 24.....	83	11	"	" 10, '14	25	"
76.74 N.- " 1.....	84	11	"	" 12, '14	13 34	"
24.88 N.- " 25.....	84	11	"	" 14, '14	30	"
40.00 W.- " 6.....	3	12	"	May 21, '15	10 54	C. M. Walker.
40.00 W.- " 6.....	3	12	"	" 23, '15	53	"
73.46 E.- " 33.....	80	12	"	Aug. 11, '14	9 53	G. H. Herriot.
73.46 E.- " 33.....	80	12	"	" 11, '14	59	"
19.38 E.-NW. " 31.....	84	12	"	" 18, '14	12 19	B. W. Waugh.
80.52 E.-NE. " 33.....	84	12	"	" 20, '14	15 20	"
15.64 E.-NW. " 31.....	84	13	"	" 21, '14	10 13	"
28.33 E.-NE. " 31.....	84	13	"	" 22, '14	11 10	"
79.37 E.- " 31.....	84	13	"	" 24, '14	12 05	"
61.11 E.- " 35.....	84	13	"	" 26, '14	14 48	"
52.91 E.- " 34.....	84	14	"	" 29, '14	8 57	"
9.88 N.- " 14.....	14	15	"	" 2, '15	10 28	W. A. Scott.
70.00 N.- " 10.....	14	15	"	" 3, '15	42	"
30.00 N.- " 17.....	14	15	"	" 18, '15	9 34	"
36.30 E.-NW. " 31.....	84	15	"	Sept. 3, '14	7 41	B. W. Waugh.
26.27 E.-NE. " 33.....	84	15	"	" 5, '14	9 42	"
63.71 E.- " 34.....	84	15	"	" 7, '14	8 51	"
61.25 E.- " 35.....	84	15	"	" 8, '14	51	"
14.75 N.- " 24.....	13	16	"	" 3, '15	12	W. A. Scott.
39.00 N.-SE. " 3.....	13	16	"	" 22, '15	11 57	"
20.00 E.-NE. " 29.....	13	16	"	" 22, '15	10 23	"
30.00 N.-} " 9.....	13	16	"	" 23, '15	35	"
18.00 E.-} " 22.....	13	16	"	" 24, '15	58	"
8.00 N.- " 5.....	13	16	"	" 24, '15	11 01	"
35.00 E.- " 3.....	13	16	"	" 27, '15	10 28	"
15.00 E.- " 27.....	13	16	"	" 27, '15	11 10	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
20.00 N.-NE. cor. sec. 14.....	13	16	E. Pr.	Oct. 1, '15	10 49	W. A. Scott.
49.19 E. " " 34.....	80	16	"	Sept. 10, '14	9 32	G. H. Herriot.
49.19 E. " " 34.....	80	16	"	" 10, '14	27	"
49.19 E. " " 34.....	80	16	"	" 10, '14	24	"
21.20 E. NW. " 31.....	84	16	"	" 9, '14	03	B. W. Waugh.
25.00 N. NE. " 5.....	13	17	"	Oct. 6, '15	12	W. A. Scott.
70.89 E. " " 35.....	84	17	"	Sept. 25, '14	8 50	B. W. Waugh.
75.88 E. " " 35.....	80	18	"	" 28, '14	9 48	G. H. Herriot.
31.51 E. NW. " 31.....	84	19	"	" 30, '14	9 06	B. W. Waugh.
66.06 E. NE. " 34.....	84	19	"	Oct. 6, '14	6 22	"
30.69 E. NW. " 31.....	80	20	"	" 6, '14	9 35	G. H. Herriot.
69.00 E. NE. " 31.....	80	20	"	" 7, '14	9 03	"
30.01 E. " " 32.....	84	20	"	" 7, '14	8 21	B. W. Waugh.
33.24 E. " " 32.....	84	21	"	Nov. 23, '14	36	G. H. Herriot.
67.86 E. " " 33.....	84	21	"	" 25, '14	25	"
25.20 E. " " 35.....	88	21	"	" 23, '14	16	B. W. Waugh.
25.20 E. " " 35.....	88	21	"	" 23, '14	16	"
25.20 E. " " 35.....	88	21	"	" 23, '14	14	"
52.00 E. " " 32.....	84	22	"	" 30, '14	10 46	G. H. Herriot.
12.72 N. " " 25.....	85	22	"	Dec. 7, '14	11 23	"
40.44 N. " " 14.....	87	22	"	" 16, '14	9 30	"
39.03 N. " " 2.....	88	22	"	" 19, '14	9 25	"
28.57 E. " " 33.....	88	22	"	Nov. 26, '14	7 48	B. W. Waugh.
16.53 N. " " 21.....	91	22	"	Dec. 5, '14	8 29	"
35.00 N. " " 13.....	74	1	Pr.	Sept. 6, '15	14 26	R. B. McKay.
At " " 13.....	74	1	"	" 7, '15	02	"
T.H. N. " " 36.....	81	1	"	" 8, '14	13 21	A. H. Hawkins.
75.90 N. " " 25.....	84	1	"	Aug. 27, '14	16 16	"
75.90 N. " " 25.....	84	1	"	" 28, '14	05	"
75.90 N. " " 25.....	84	1	"	Sept. 4, '14	16 21	"
52.60 N. " " 36.....	85	1	"	Aug. 13, '14	15 22	"
52.60 N. " " 36.....	85	1	"	" 13, '14	24	"
10.20 N. " " 24.....	86	1	"	" 14, '14	16 46	"
10.20 N. " " 24.....	86	1	"	" 14, '14	16 45	"
10.20 N. " " 24.....	86	1	"	" 17, '14	39	"
10.20 N. " " 24.....	86	1	"	" 18, '14	39	"
10.20 N. " " 24.....	86	1	"	" 20, '14	40	"
10.20 N. " " 24.....	86	1	"	" 21, '14	39	"
10.20 N. " " 24.....	86	1	"	" 24, '14	44	"
10.20 N. " " 24.....	86	1	"	" 25, '14	43	"
10.20 N. " " 24.....	86	1	"	" 26, '14	34	"
At " " 12.....	87	1	"	" 15, '14	12 19	"
43.00 S. " " 21.....	34	5	"	Dec. 9, '15	15 19	J. W. Tyrrell.
48.00 S. " " 20.....	34	5	"	" 10, '15	10	"
20.00 E. SE. " 5.....	35	5	"	" 4, '15	12	"
6.70 E. NE. " 31.....	36	5	"	July 18, '15	13 37	R. B. McKay.
2.00 N. " " 1.....	69	5	"	Dec. 9, '14	14 42	P. B. Street.
20.00 W. " " 20.....	70	5	"	Jan. 9, '15	15 01	"
20.00 N. " " 12.....	70	5	"	" 17, '15	26	"
20.00 S. " " 24.....	70	5	"	Feb. 14, '15	27	"
10.00 N. " " 10.....	70	5	"	" 26, '15	36	"
20.00 N. " " 26.....	70	5	"	Mar. 7, '15	31	"
10.00 W. " " 31.....	33	6	"	Aug. 20, '15	14 04	J. W. Tyrrell.
45.00 S. " " 21.....	33	6	"	" 25, '15	26	"
At " " 7.....	33	6	"	" 31, '15	08	"
40.00 W. " " 16.....	33	6	"	Sept. 2, '15	05	"
10.00 S. " " 7.....	34	6	"	" 16, '15	12	"
5.00 N. " " 19.....	34	6	"	" 17, '15	33	"
42.00 W. SE. " 2.....	35	6	"	Nov. 2, '15	15 01	"
40.00 S. NE. " 9.....	35	6	"	" 22, '15	14 54	"
30.00 N. " " 21.....	35	6	"	" 24, '15	42	"
30.00 S. " " 3.....	35	6	"	" 25, '15	15 04	"
At " " 36.....	35	6	"	Dec. 1, '15	14 39	"
2.00 N. " " 25.....	69	6	"	" 15, '14	15 41	P. B. Street.
At " " 22.....	70	6	"	Nov. 18, '14	15 16	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
5.00 S. NE. cor. sec. 26.....	70	6	Pr.	Nov. 19, '14	14 49	P.B. Street.
12.00 N. " " 21.....	70	6	"	" 24, '14	14 34	"
38.00 N. " " 20.....	70	6	"	Jan. 1, '15	37	"
18.00 S. " " 26.....	70	6	"	" 23, '15	49	"
65.00 S. " " 8.....	70	6	"	" 25, '15	45	"
At " " 22.....	33	7	"	Aug. 10, '15	15 03	J. W. Tyrrell.
20.00 N. " " 13.....	33	7	"	" 12, '15	14 57	"
20.00 W. " " 25.....	33	7	"	" 30, '15	33	"
30.00 S. " " 25.....	34	7	"	Sept. 8, '15	27	"
10.00 S. " " 10.....	34	7	"	" 9, '15	55	"
20.00 N. " " 15.....	34	7	"	" 10, '15	38	"
24.00 W. " " 23.....	34	7	"	" 14, '15	28	"
10.00 N. " " 25.....	35	7	"	Oct. 27, '15	19	"
16.00 S.- " " 12.....	35	7	"	" 29, '15	29	"
25.00 S.- " " 3.....	35	7	"	Nov. 5, '15	27	"
20.00 E.- " " 23.....	35	7	"	" 8, '15	29	"
30.00 S.- " " 1.....	36	7	"	Oct. 26, '15	10	"
45.00 N.- " " 24.....	69	7	"	" 12, '14	43	P. B. Street.
38.00 N.- " " 1.....	70	7	"	" 25, '14	43	"
At $\frac{1}{4}$ cor. N. by. sec. 24.....	34	9	"	Feb. 25, '15	32	W. J. Deans.
At $\frac{1}{4}$ " " 24.....	34	9	"	" 27, '15	28	"
5.00 N.-NE. cor. sec. 24.....	34	9	"	" 27, '15	15 02	"
5.00 S.- " " 13.....	65	10	"	Jan. 2, '15	14 30	P. E. Palmer.
10.00 N.- " " 24.....	65	10	"	" 4, '15	13 25	"
35.00 N.- " " 36.....	65	10	"	" 5, '15	15 27	"
18.00 N.- " " 12.....	66	10	"	" 6, '15	14 26	"
22.00 N.- " " 24.....	66	10	"	" 8, '15	11 12	"
47.00 E.- " " 10.....	66	10	"	" 15, '15	12 41	"
56.00 S.- " " 7.....	66	10	"	" 18, '15	22 33	"
24.00 N.- " " 9.....	66	10	"	" 21, '15	10 26	"
0.36 E.- " " 32.....	32	12	"	Feb. 18, '15	14 49	W. J. Deans.
0.36 E.- " " 32.....	32	12	"	" 18, '15	45	"
At Sta. A5, traverse in sec. 27.....	48	13	"	Sept. 22, '14	14 46	"
" " 27.....	48	13	"	" 22, '14	46	"
" " 27.....	48	13	"	" 22, '14	41	"
At W.P. in Grand Rapids settlement.	48	13	"	" 23, '14	58	"
54.71 S.-NE. cor. sec. 34.....	48	13	"	" 23, '14	31	"
54.71 S.- " " 34.....	48	13	"	" 23, '14	23	"
40.00 E.- " " 21.....	48	13	"	" 25, '14	52	"
40.00 E.- " " 21.....	48	13	"	" 25, '14	51	"
68.00 W.- " " 32.....	34	15	"	" 8, '15	15 50	O. Rolfson.
20.00 W.- " " 28.....	34	15	"	" 6, '15	14 49	"
44.00 S.- " " 3.....	35	15	"	" 2, '15	15 13	"
3.00 E.-SW. " 3.....	35	15	"	" 3, '15	37	"
30.00 W.-NE. " 26.....	35	15	"	Aug. 30, '15	29	"
1.00 N.- " " 11.....	35	15	"	" 31, '15	14 59	"
36.00 S.- " " 11.....	36	15	"	" 26, '15	15 40	"
40.00 W.- " " 24.....	36	15	"	" 26, '15	14 57	"
60.00 W.- " " 11.....	37	15	"	" 2, '15	30	"
20.00 S.- " " 16.....	37	15	"	" 5, '15	29	"
At " " 29.....	37	15	"	" 12, '15	15 00	"
At " " 18.....	38	15	"	" 12, '15	14 37	"
At " " 10.....	38	15	"	" 14, '15	50	"
65.00 W.- " " 24.....	38	15	"	" 20, '15	15 13	"
At " " 14.....	38	15	"	" 18, '15	14 57	"
At SE. " 1.....	35	16	"	Jan. 25, '15	37	W. J. Deans.
At NE " 31.....	37	16	"	July 1, '15	13 27	O. Rolfson.
28.00 N.- " " 28.....	37	16	"	" 8, '15	32	"
At " " 19.....	37	16	"	" 13, '15	16	"
30.00 N.- " " 8.....	37	16	"	" 16, '15	18	"
At " " 16.....	37	16	"	" 19, '15	14 10	"
At " " 8.....	37	16	"	" 26, '15	13 19	"
65.00 W.- " " 7.....	37	16	"	" 27, '15	26	"
12.00 N.- " " 8.....	37	16	"	" 30, '15	35	"
25.85 W.- " " 5.....	38	16	"	" 3, '15	13 48	"
43.00 N.- " " 4.....	38	16	"	" 5, '15	14 17	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
6.00 N.- NE. cor. sec. 26.....	34	17	Pr	Jan 24, '15	15 03	W. J. Deans.
6.00 N.- " " 26.....	34	17	"	" 24, '15	14 59	"
5.00 N.- " " 23.....	34	17	"	" 25, '15	15 05	"
65.00 N.- " " 9.....	37	17	"	May 26, '15	14 12	O. Rolfson.
40.00 N.- " " 28.....	37	17	"	" 28, '15	13 47	"
At " " 34.....	37	17	"	June 1, '15	14 26	"
15.00 N.- " " 8.....	38	17	"	" 7, '15	15 30	"
At " " 16.....	38	17	"	" 12, '15	37	"
At " " 10.....	38	17	"	" 17, '15	30	"
28.00 N.- " " 15.....	38	17	"	" 18, '15	57	"
At " " 24.....	38	17	"	" 23, '15	09	"
20.00 W.- " " 1.....	38	17	"	" 25, '15	21	"
30.00 N.- " " 13.....	61	18	"	Feb. 15, '15	17 55	J. S. Galletly.
70.00 N.- " " 24.....	61	18	"	" 15, '15	18 00	"
15.00 N.- " " 25.....	61	18	"	" 16, '15	04	"
At " " 1.....	61	18	"	" 13, '15	08	"
30.00 N.- " " 1.....	61	18	"	" 14, '15	09	"
70.00 N.- " " 12.....	61	18	"	" 14, '15	13	"
25.00 S.- " " 20.....	62	18	"	" 25, '15	17 58	"
65.00 S.- " " 17.....	62	18	"	" 25, '15	27	"
At " " 33.....	62	18	"	" 26, '15	18 05	"
20.00 N.- " " 9.....	62	18	"	" 27, '15	17 41	"
At " " 34.....	62	18	"	May 1, '15	18 03	"
15.00 N.- " " 22.....	62	18	"	" 1, '15	12	"
40.00 S.- " " 35.....	62	18	"	" 2, '15	17 49	"
20.00 N.- " " 23.....	62	18	"	" 2, '15	18 10	"
20.00 W.- " " 24.....	62	18	"	" 3, '15	17 45	"
At " " 20.....	62	18	"	Feb. 24, '15	18 11	"
28.00 W.- " " 19.....	62	18	"	Jan. 18, '15	17 47	"
55.00 W.- " " 20.....	62	18	"	" 21, '15	18 13	"
40.00 W.- " " 7.....	62	18	"	" 22, '15	26	"
5.00 N. NE. cor. sec. 7.....	62	18	"	" 25, '15	22	"
At " " 19.....	62	18	"	" 25, '15	33	"
55.00 E.- " " 20.....	62	18	"	" 29, '15	17 58	"
30.00 W.- " " 9.....	62	18	"	" 26, '15	47	"
55.00 N.- " " 1.....	62	18	"	Feb. 16, '15	52	"
At " " 12.....	62	18	"	" 18, '15	55	"
15.00 N.- " " 24.....	62	18	"	" 19, '15	33	"
30.00 W.- " " 36.....	62	18	"	" 19, '15	31	"
30.00 W.- " " 36.....	62	18	"	" 22, '15	46	"
At " " 35.....	62	18	"	" 22, '15	18 11	"
35.00 W.- " " 34.....	62	18	"	" 23, '15	07	"
55.00 S.- " " 32.....	62	18	"	" 23, '15	07	"
70.00 S.- " " 32.....	62	18	"	" 24, '15	09	"
70.00 S.- " " 36.....	63	18	"	" 6, '15	13 44	"
70.00 S.- " " 36.....	63	18	"	" 8, '15	42	"
25.00 S.- " " 1.....	63	18	"	" 9, '15	18 01	"
40.00 N.- " " 12.....	64	18	"	" 4, '15	13 48	"
15.00 S.- " " 30.....	61	19	"	Dec. 31, '14	18 19	"
At " " 20.....	61	19	"	Jan 1, '15	17 08	"
At " " 20.....	61	19	"	" 2, '15	08	"
30.00 S.- " " 33.....	61	19	"	" 4, '15	11	"
At " " 36.....	61	19	"	" 15, '15	10	"
At " " 7.....	62	19	"	" 5, '15	19 58	"
35.00 W.- " " 7.....	62	19	"	" 6, '15	20 05	"
35.00 W.- " " 7.....	62	19	"	" 7, '15	09	"
60.00 W.- " " 9.....	62	19	"	" 7, '15	16 24	"
35.00 S.- " " 8.....	62	19	"	" 8, '15	41	"
15.00 N.- " " 4.....	62	19	"	" 9, '15	18 20	"
15.00 N.- " " 4.....	62	19	"	" 11, '15	14	"
8.00 E.- " " 10.....	62	19	"	" 11, '15	14 01	"
20.00 N.- " " 10.....	62	19	"	" 12, '15	57	"
35.00 E.- " " 22.....	62	19	"	" 14, '15	38	"
At " " 1.....	62	19	"	" 16, '15	18 34	"
At " " 2.....	62	19	"	" 19, '15	16 45	"
50.00 N.- " " 14.....	62	19	"	" 20, '15	50	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
15.00 S. N.E.cor.sec.23.....	62	19	Pr.	Jan. 20, '15	16 24	J. S. Galletly.
50.00 S. " " 12.....	62	20	"	" 6, '15	19 34	"
At ¼ sec. cor. N. by sec. 32.....	60	21	"	Sept. 21, '15	16 08	R. B. McKay.
20.00 S. NE. cor. sec. 9.....	3	22	"	Oct. 28, '15	28	C. M. Walker.
At " " 28.....	3	22	"	" 29, '15	22	"
40.00 S. " " 31.....	43	25	"	Mar. 26, '15	33	W. J. Deans.
40.00 S. " " 31.....	43	25	"	" 26, '15	31	"
20.00 E. " " 31.....	24	27	"	July 30, '15	17 06	C. F. Aylsworth.
42.00 W. " " 32.....	24	27	"	Aug. 2, '15	16 52	"
5.00 S. " " 31.....	24	27	"	" 3, '15	57	"
41.50 S. " " 19.....	24	27	"	" 4, '15	32	"
21.00 S. " " 29.....	24	27	"	" 5, '15	40	"
69.50 S. " " 29.....	24	27	"	" 6, '15	43	"
At " " 29.....	24	27	"	" 9, '15	37	"
At " " 28.....	24	27	"	" 10, '15	17 17	"
6.00 S. " " 7.....	24	27	"	" 17, '15	16 07	"
2.00 W. " " 19.....	24	27	"	" 19, '15	39	"
30.00 W. " " 7.....	24	27	"	" 20, '15	09	"
18.50 N. " " 5.....	24	27	"	" 24, '15	23	"
11.50 W. " " 8.....	24	27	"	" 25, '15	23	"
19.00 W. " " 8.....	24	27	"	" 26, '15	32	"
64.50 N. " " 6.....	25	27	"	Sept. 9, '15	17 01	"
64.50 N. " " 6.....	25	27	"	" 14, '15	35	"
16.50 N. " " 4.....	25	27	"	" 21, '15	04	"
40.50 N. " " 28.....	25	27	"	" 26, '15	16 30	"
34.40 E. " " 29.....	25	27	"	" 29, '15	53	"
3.50 N. " " 19.....	25	27	"	" 30, '15	17 08	"
54.40 N. " " 30.....	25	27	"	Oct. 1, '15	16 55	"
25.50 E. " " 33.....	26	30	"	June 11, '15	36	"
28.80 W. " " 26.....	26	30	"	" 14, '15	15 43	"
At NW. " 18.....	23	31	"	" 18, '15	17 33	"
At NE. " 18.....	23	31	"	" 22, '15	31	"
21.00 N. " " 18.....	23	31	"	" 23, '15	18	"
11.50 N. " " 20.....	23	31	"	" 28, '15	19	"
20.00 W. " " 8.....	23	31	"	" 29, '15	25	"
At " " 16.....	23	31	"	July 4, '15	11	"
At " " 15.....	23	31	"	" 7, '15	23	"
7.00 E. " " 15.....	23	31	"	" 8, '15	16	"
20.00 S. " " 11.....	23	31	"	" 9, '15	20	"
3.00 N. " " 11.....	23	31	"	" 11, '15	10	"
38.00 W. " " 23.....	23	31	"	" 12, '15	02	"
20.00 E. " " 10.....	23	31	"	" 13, '15	28	"
1.50 N. " " 1.....	23	31	"	" 14, '15	14	"
At " " 15.....	23	31	"	" 18, '15	17	"
At " " 15.....	23	31	"	" 18, '15	16	"
30.00 W. " " 33.....	28	31	"	" 21, '15	18 40	"
At " " 28.....	28	31	"	" 23, '15	50	"
20.00 S. " " 33.....	28	31	"	" 24, '15	19 06	"
9.50 N. " " 4.....	29	31	"	" 27, '15	18 19	"
At " " 36.....	32	1	2	Oct. 8, '15	16 45	R. B. McKay.
19.60 N. " " 13.....	61	1	2	" 20, '14	19 44	A. H. Hawkins.
23.70 N. " " 13.....	61	1	2	" 21, '14	54	"
19.60 N. " " 13.....	61	1	2	" 22, '14	49	"
9.75 N. " " 12.....	62	1	2	" 28, '14	01	"
At " " 13.....	77	1	2	Dec. 25, '14	20 21	"
77.00 N. " " 24.....	79	1	2	Jan. 4, '15	11	"
77.00 N. " " 24.....	79	1	2	" 5, '15	19 38	"
77.00 N. " " 24.....	79	1	2	" 7, '15	28	"
77.00 N. " " 24.....	79	1	2	" 8, '15	20 12	"
77.00 N. " " 24.....	79	1	2	" 10, '15	10	"
77.00 N. " " 24.....	79	1	2	" 11, '15	11	"
77.00 N. " " 24.....	79	1	2	" 12, '15	10	"
77.00 N. " " 24.....	79	1	2	" 13, '15	10	"
Sta. 3, Trav. lake No. 1, sec. 7.....	13	4	2	June 27, '15	17 25	C. Rinfret.
Sta. 2 " " 27.....	12	10	2	" 18, '15	18 31	"
" " " 27.....	12	10	2	" 19, '15	19	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
					° ' "	
Sta. 2, Trav. lake No. 1, sec. 27.....	12	10	2	June 19, '15	18 31	C. Rinfret
“ “ “ 27.....	12	10	2	“ 21, '15	36	“
“ “ “ 27.....	12	10	2	“ 22, '15	40	“
Sta. 5, Trav. Moose Mountain lake, sec. 20.....	14	10	2	July 4, '15	18 44	“
“ “ “ 20..	14	10	2	“ 4, '15	42	“
“ “ “ 20..	14	10	2	“ 4, '15	47	“
40·00 N. NE. cor. sec. 16.....	32	10	2	Sept. 17, '15	19 55	W. A. Fletcher.
At “ “ 8.....	33	10	2	Oct. 3, '15	27	“
Sta. 19, Trav. Chapleau lake, sec. 26..	14	11	2	July 9, '15	18 19	C. Rinfret.
“ “ “ 26..	14	11	2	“ 11, '15	27	“
“ “ “ 26..	14	11	2	“ 11, '15	40	“
“ “ “ 26..	14	11	2	“ 12, '15	26	“
At NE. cor. sec. 36.....	15	11	2	“ 5, '15	19 02	“
Sta. 3, Trav. lake in sec. 30.....	15	11	2	“ 7, '15	18 49	“
3·00 S. NE. cor. sec. 9.....	27	11	2	Oct. 16, '15	49	W. A. Fletcher.
6·50 N. “ 5.....	27	11	2	“ 20, '15	19 23	“
Sta. 2, Trav. lake in sec. 26.....	14	12	2	July 19, '15	18 34	C. Rinfret.
“ “ 26.....	14	12	2	“ 25, '15	28	“
“ “ 26.....	14	12	2	“ 26, '15	34	“
“ “ 26.....	14	12	2	“ 26, '15	36	“
42·00 N. NE. cor. sec. 17.....	33	13	2	May 28, '15	20 15	J. H. McKnight.
29·00 E. NW. “ 19.....	33	13	2	June 1, '15	07	“
30·00 N. NE. “ 17.....	15	14	2	Aug. 2, '15	18 36	C. Rinfret.
At “ “ 14.....	27	14	2	June 12, '15	19 27	W. A. Fletcher.
40·00 W. “ “ 4.....	28	14	2	“ 23, '15	18 56	“
40·00 W. “ “ 4.....	28	14	2	“ 20, '15	19 07	“
41·00 N. “ “ 8.....	36	14	2	“ 9, '15	19 50	J. H. McKnight.
At “ “ 18.....	37	14	2	“ 28, '15	20 07	“
40·00 W. “ “ 10.....	38	14	2	“ 29, '15	19 38	“
40·00 S. “ “ 2.....	16	15	2	Aug. 5, '15	18 43	C. Rinfret.
15·00 E. “ “ 22.....	27	15	2	July 25, '15	25	W. A. Fletcher.
40·00 S. “ “ 16.....	28	15	2	“ 4, '15	10	“
At “ “ 16.....	28	15	2	“ 6, '15	07	“
69·00 W. “ “ 36.....	38	15	2	“ 20, '15	20 21	J. H. McKnight.
At “ “ 7.....	38	15	2	Aug. 9, '15	11	“
41·00 N. “ “ 20.....	39	15	2	“ 10, '15	15	“
33·50 N. “ “ 5.....	15	16	2	“ 7, '15	18 36	C. Rinfret.
33·50 N. “ “ 5.....	15	16	2	“ 8, '15	35	“
33·50 N. “ “ 5.....	15	16	2	“ 8, '15	36	“
33·50 N. “ “ 5.....	15	16	2	“ 9, '15	37	“
40·00 W. “ “ 22.....	28	16	2	“ 23, '15	07	W. A. Fletcher.
40·00 N. “ “ 4.....	38	16	2	Sept. 27, '15	19 54	J. H. McKnight.
0·06 N. “ “ 31.....	14	17	2	Aug. 20, '15	18 47	C. Rinfret.
Sta. 3, Trav. lake, sec. 26.....	15	17	2	“ 10, '15	42	“
“ “ 26.....	15	17	2	“ 12, '15	38	“
“ “ 26.....	15	17	2	“ 15, '15	47	“
“ “ 26.....	15	17	2	“ 15, '15	38	“
39·00 S. NE. cor. sec. 6.....	15	17	2	“ 23, '15	47	“
4·00 N. “ “ 15.....	29	17	2	Sept. 5, '15	55	W. A. Fletcher.
56·00 E. “ “ 35.....	38	17	2	Oct. 13, '15	19 56	J. H. McKnight.
40·00 E. NE. “ 9.....	39	17	2	“ 18, '15	31	“
56·00 N. “ “ 16.....	40	17	2	“ 20, '15	47	“
15·00 N. “ “ 10.....	39	18	2	“ 30, '15	41	“
14·00 N. “ “ 10.....	41	18	2	Nov. 1, '15	53	“
Sta. 4, Trav. lake in sec. 29.....	3	19	2	June 6, '15	17 46	C. Rinfret.
“ “ 29.....	3	19	2	“ 8, '15	43	“
“ “ 29.....	3	19	2	“ 8, '15	33	“
23·30 on bea. 251° 43' from NE. cor. sec. 11.....	12	20	2	Sept. 9, '15	18 30	“
23·30 on bea. 251° 43' from NE. cor. sec. 11.....	12	20	2	“ 9, '15	14	“
23·30 on bea. 251° 43' from NE. cor. sec. 11.....	12	20	2	“ 10, '15	20	“

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
					° /	
40.00 W.-NE. cor. sec. 29.....	53	20	2	Oct. 1, '15	21 59	W. Christie.
16.00 S.-" 29.....	53	20	2	" 4, '15	22 13	"
35.00 N.-" 4.....	52	21	2	Sept. 3, '15	21 14	"
At " 9.....	52	21	2	" 4, '15	33	"
50.00 N.-" 4.....	52	21	2	" 5, '15	30	"
At " 11.....	52	21	2	" 6, '15	02	"
At " 13.....	52	21	2	" 7, '15	22 11	"
At " 22.....	52	21	2	" 8, '15	03	"
30.00 W.-" 29.....	52	21	2	" 13, '15	21 02	"
42.00 W.-" 30.....	52	21	2	" 14, '15	08	"
36.00 W.-" 31.....	52	21	2	" 20, '15	20 50	"
40.00 S.-" 22.....	53	21	2	" 10, '15	21 40	"
20.00 N.-" 5.....	53	21	2	" 16, '15	20 57	"
42.00 N.-" 20.....	53	21	2	" 17, '15	21 14	"
24.00 E.-" 32.....	53	21	2	" 23, '15	34	"
13.60 on bea. 265° 13' from NE. cor. sec. 9.....	11	22	2	Oct. 20, '15	18 34	C. Rinfret..
13.60 on bea. 265° 13' from NE. cor. sec. 9.....	11	22	2	" 21, '15	38	"
13.60 on bea. 265° 13' from NE. cor. sec. 9.....	11	22	2	" 21, '15	34	"
Sta. 14, Trav. Moosejaw creek, sec. 34	13	22	2	Sept. 23, '15	36	"
22.00 on bea. 292° 25' of ¼ sec. cor. E. by sec. 23.....	14	22	2	" 22, '15	38	"
22.00 on bea. 292° 25' of ¼ sec. cor. E. by sec. 23.....	14	22	2	" 26, '15	37	"
22.00 on bea. 292° 25' of ¼ sec. cor. E. by sec. 23.....	14	22	2	" 26, '15	40	"
22.00 on bea. 292° 25' of ¼ sec. cor. E. by sec. 23.....	14	22	2	" 26, '15	38	"
At. NE. cor. sec. 20.....	38	22	2	Aug. 17, '15	20 32	R. Neelands.
40.00 S.-NE. cor. sec. 31.....	39	22	2	" 10, '15	22	"
15.00 N.-" 13.....	53	22	2	July 23, '15	19 19	W. Christie.
At " 36.....	53	22	2	" 24, '15	25	"
35.00 W.-" 34.....	53	22	2	" 26, '15	21 17	"
33.00 S.-" 29.....	53	22	2	Aug. 12, '15	22 16	"
At " 22.....	53	22	2	" 14, '15	21 51	"
20.00 S.-" 27.....	53	22	2	" 16, '15	49	"
20.00 N.-" 26.....	53	22	2	" 17, '15	19 57	"
At " 14.....	53	22	2	" 19, '15	23	"
22.90 S.-" 11.....	53	22	2	" 23, '15	18 27	"
35.00 W.-" 9.....	53	22	2	" 24, '15	24 01	"
40.00 W.-" 7.....	54	22	2	July 20, '15	22 33	"
20.00 S.-" 7.....	54	22	2	" 30, '15	21 59	"
12.00 N.-" 18.....	54	22	2	" 31, '15	55	"
At " 7.....	54	22	2	Aug. 2, '15	36	"
20.00 S.-" 22.....	54	22	2	" 5, '15	20 56	"
20.00 S.-" 12.....	54	22	2	" 7, '15	21	"
55.00 W.-" 10.....	54	22	2	" 10, '15	08	"
Sta. 3, Trav. Dahinda lake, sec. 15	9	23	2	May 31, '15	18 49	C. Rinfret.
" " " 15	9	23	2	June 1, '15	51	"
" " " 15	9	23	2	" 1, '15	53	"
Sta. 2, Trav. lake in sec. 18.....	11	23	2	Oct. 18, '15	58	"
" " " 18.....	11	23	2	" 19, '15	19 02	"
18.55 on bea. 152° 35' of ¼ M. on N. by sec. 22.....	12	23	2	Sept. 30, '15	12	"
18.55 on bea. 152° 35' of ¼ M. on N. by sec. 22.....	12	23	2	Oct. 1, '15	09	"
18.55 on bea. 152° 35' of ¼ M. on N. by sec. 22.....	12	23	2	" 1, '15	09	"
26.60 on bea. 91° 27' of NE. cor. sec. 12.	13	23	2	Sept. 30, '15	16	"
" " " 12	13	23	2	" 30, '15	13	"
Sta. 7, Trav. Moosejaw creek, sec. 30.	15	23	2	" 16, '15	21	"
" " " 30	15	23	2	" 17, '15	34	"
" " " 30	15	23	2	" 17, '15	28	"
" " " 30	15	23	2	" 17, '15	16	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—*Continued.*Table 1.—*Declination Observations.* Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
7.00 S.-NE. cor. sec. 5.....	41	23	2	Oct. 18, '15	20 03	J. M. Côté.
20.00 S.-" 12.....	41	23	2	" 19, '15	19 50	"
25.00 E.-" 9.....	41	23	2	" 22, '15	58	"
At " 36.....	53	23	2	July 28, '15	21 21	W. Christie.
At " 8.....	54	23	2	June 30, '15	23 00	"
At " 19.....	54	23	2	July 5, '15	27	"
40.00 W.-" 21.....	54	23	2	" 6, '15	06	"
At " 8.....	54	23	2	" 7, '15	22 53	"
At " 20.....	54	23	2	" 8, '15	51	"
30.00 W.-" 16.....	54	23	2	" 10, '15	23 41	"
20.00 N.-" 2.....	54	23	2	" 17, '15	07	"
Sta. 3, Trav. lake in sec. 2.....	12	24	2	Oct. 12, '15	18 49	C. Rinfret.
" " 2.....	12	24	2	" 14, '15	31	"
" " 2.....	12	24	2	" 14, '15	19 03	"
" " 2.....	12	24	2	" 15, '15	18 57	"
At NE. cor. sec. 34.....	23	24	2	June 7, '15	19 42	P. E. Palmer.
At " 20.....	42	24	2	" 30, '15	50	R. Neelands.
2.00 S.-" 23.....	44	24	2	May 26, '15	48	"
At " 27.....	53	24	2	June 2, '15	22 52	W. Christie.
At " 28.....	53	24	2	" 3, '15	29	"
At " 19.....	53	24	2	" 5, '15	43	"
At " 29.....	53	24	2	" 7, '15	29	"
36.00 W.-" 20.....	54	24	2	" 11, '15	23 23	"
10.00 W.-" 18.....	54	24	2	" 12, '15	22 53	"
60.00 W.-" 6.....	54	24	2	" 15, '15	34	"
At " 8.....	54	24	2	" 16, '15	39	"
At " 22.....	54	24	2	" 21, '15	43	"
At " 1.....	54	24	2	" 22, '15	23 12	"
At " 11.....	54	24	2	" 23, '15	22 41	"
4.00 S.-" 24.....	54	24	2	" 24, '15	51	"
Sta. 3, Trav. lake in sec. 25.....	11	25	2	Oct 3, '15	19 04	C Rinfret.
" " 25.....	11	25	2	" 5, '15	11	"
" " 25.....	11	25	2	" 11, '15	13	"
Sta 2, Trav. Gould lake in sec 17..	11	25	2	" 4, '15	19 06	"
32.00 N-NE., cor. sec. 21.....	21	25	2	June 1, '15	20 34	P E Palmer.
18.00 S.-" 4.....	22	25	2	" 2, '15	33	"
12.00 E.- $\frac{1}{4}$ on E. by sec. 4.....	24	25	2	" 5, '15	19 56	"
16.00 W.- $\frac{1}{4}$ " 4.....	24	25	2	" 7, '15	20 02	"
5.00 N.-NE. cor. sec. 21.....	37	25	2	Aug 24, '15	19 59	R. Neelands.
20.00 W.-" 35.....	23	26	2	June 9, '15	20 25	P. E. Palmer.
At " 34.....	25	26	2	" 11, '15	10	"
40.00 S.-" 28.....	25	26	2	" 11, '15	13	"
40.00 S.-" 28.....	25	26	2	" 13, '15	06	"
At " 9.....	27	26	2	" 14, '15	39	"
At " 9.....	27	26	2	" 15, '15	48	"
At " 9.....	28	26	2	" 21, '15	50	"
At " 16.....	29	26	2	Sept. 8, '15	53	"
20.00 N.-SE.-" 3.....	31	26	2	June 26, '15	21 00	"
16.00 S.-NE. " 18.....	32	26	2	Oct. 8, '15	21 16	"
40.00 W.-" 24.....	42	26	2	June 15, '15	19 56	R. Neelands.
At " 10.....	43	26	2	" 4, '15	35	"
12.00 N.-" 9.....	13	27	2	May 16, '15	26	S. L. Evans.
4.00 N.-SE. " 1.....	13	27	2	" 18, '15	26	"
12.00 N.-" 2.....	13	27	2	" 18, '15	23	"
36.00 N.-" 3.....	13	27	2	" 19, '15	21	"
24.00 N.-" 5.....	13	27	2	" 19, '15	28	"
9.00 N.-" 6.....	13	27	2	" 21, '15	13	"
2.00 N.-SW. " 6.....	13	27	2	" 21, '15	11	"
1.00 S.-NE. " 20.....	13	27	2	" 22, '15	15	"
7.00 S.-" 21.....	13	27	2	" 25, '15	19	"
3.00 S.-" 22.....	13	27	2	" 25, '15	17	"
24.00 W.-" 32.....	27	27	2	July 5, '15	20 50	P. E. Palmer.
At " 31.....	27	27	2	" 12, '15	21 14	"
8.00 W.-" 34.....	28	27	2	June 28, '15	20 52	"
At " 14.....	29	27	2	Sept. 4, '15	59	"
40.00 S.-" 22.....	30	27	2	" 16, '15	20 59	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
10.00 E.- $\frac{1}{4}$ pits E. by sec. 28.....	31	27	2	Sept. 19, '15	21 09	P. E. Palmer.
7.40 E.-NE. cor. sec. 7.....	33	27	2	Oct. 13, '15	20 54	"
At " 2.....	33	27	2	" 18, '15	21 22	"
15.00 N.- " 21.....	37	27	2	Aug. 29, '15	11	R. Neelands.
30.00 W.- " 21.....	38	27	2	Sept. 5, '15	43	"
45.00 S.- " 3.....	43	27	2	Oct. 12, '15	20 28	J. M. Côté.
At SE. " 2.....	43	27	2	" 13, '15	38	"
30.00 W.-NE. " 36.....	21	28	2	Aug. 2, '15	42	P. E. Palmer.
8.00 N.-SE. " 6.....	23	28	2	" 6, '15	18	"
40.00 N.-NE. " 36.....	24	28	2	July 20, '15	20	"
8.00 E.- " 20.....	25	28	2	" 19, '15	21 00	"
At " 31.....	27	28	2	" 10, '15	12	"
40.00 S.- " 24.....	29	28	2	Aug. 30, '15	20 59	"
40.00 W.- " 21.....	30	28	2	" 23, '15	21 07	"
At " 19.....	21	29	2	" 1, '15	20 08	"
8.00 W. " 34.....	29	29	2	" 13, '15	21 07	"
8.00 W.- " 34.....	29	29	2	" 15, '15	13	"
10.00 N.- " 25.....	24	1	3	July 22, '15	20 50	"
10.00 N.- " 25.....	24	1	3	" 25, '15	51	"
25.00 W.- $\frac{1}{4}$ E. by sec. 1.....	26	1	3	" 18, '15	53	"
At NE. cor. sec. 36.....	28	1	3	Aug. 10, '15	21 09	"
30.00 S.- " 16.....	29	1	3	" 18, '15	01	"
40.00 S.- " 15.....	30	1	3	" 19, '15	15	"
At " 12.....	68	1	3	Mar. 15, '15	23 12	R. B. McKay.
At " 12.....	68	1	3	" 20, '15	13	"
35.00 N.- " 25.....	22	2	3	July 29, '15	20 30	P. E. Palmer.
2.00 W.-SE. " 2.....	43	2	3	Aug. 5, '15	24 44	J. M. Côté.
39.00 W.-NE. " 3.....	43	2	3	" 7, '15	49	"
2.00 W.-SE. " 1.....	43	2	3	" 9, '15	25 13	"
12.00 E.-NE. " 19.....	43	2	3	" 13, '15	24 44	"
2.00 S.-NE. cor. sec. 2.....	43	2	3	" 14, '15	24 48	"
7.00 N.- " 11.....	43	2	3	" 16, '15	53	"
33.00 S.- " 17.....	43	2	3	" 18, '15	31	"
6.00 S.- " 27.....	43	2	3	" 19, '15	54	"
At " 32.....	43	2	3	" 24, '15	37	"
At " 27.....	43	2	3	" 25, '15	35	"
9.00 W.- " 24.....	43	2	3	" 28, '15	25 07	"
16.00 E.- " 34.....	43	2	3	Sept. 7, '15	20	"
13.00 N.- " 10.....	44	2	3	" 3, '15	24 38	"
30.00 E.- " 11.....	44	2	3	" 13, '15	57	"
20.00 S.- " 20.....	44	2	3	" 17, '15	24	"
55.00 W.- " 31.....	44	2	3	" 18, '15	49	"
55.00 W.- " 31.....	44	2	3	" 20, '15	34	"
54.00 N.- " 24.....	44	2	3	" 27, '15	26	"
2.00 S.- " 24.....	44	2	3	" 30, '15	27	"
At $\frac{1}{4}$ sec. cor. E. by sec. 10.....	44	2	3	Oct. 3, '15	39	R. Neelands.
At NE. cor. sec. 28.....	44	2	3	Sept. 29, '15	30	"
7.00 W.- " 29.....	45	2	3	Oct. 4, '15	50	"
40.00 S.- " 18.....	47	3	3	" 27, '15	39	"
At " 19.....	47	3	3	" 29, '15	27	"
32.00 N.-SE. " 3.....	15	4	3	June 6, '15	20 37	S. L. Evans.
8.00 N.- " 2.....	15	4	3	" 6, '15	35	"
5.00 N.- " 1.....	15	4	3	" 6, '15	42	"
1.10 N.-NE. " 6.....	15	4	3	" 18, '15	34	"
3.50 N.- " 5.....	15	4	3	" 18, '15	28	"
At " 32.....	24	4	3	July 26, '15	56	P. E. Palmer.
22.00 E.- " 33.....	15	5	3	June 12, '15	52	S. L. Evans.
11.00 N.-SE. " 4.....	15	5	3	" 14, '15	59	"
0.50 W.- " 1.....	15	5	3	" 16, '15	40	"
3.00 N.- " 2.....	15	5	3	" 16, '15	39	"
2.00 W.- " 3.....	15	5	3	" 16, '15	43	"
42.00 N.-NE. " 1.....	15	5	3	" 18, '15	49	"
20.00 S.- " 8.....	17	5	3	July 11, '15	21 05	"
46.00 N.-SE. " 4.....	17	5	3	" 15, '15	03	"
38.00 S.-NE. " 23.....	17	5	3	" 21, '15	01	"
25.00 S.- " 22.....	17	5	3	" 21, '15	20 50	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
20.00 S.-N.E. cor. sec. 5.....	32	5	3	Oct. 25, '15	22 38	S. L. Evans
32.00 S.-" 4.....	32	5	3	" 27, '15	25	"
20.00 N.-" 13.....	32	5	3	" 29, '15	26	"
31.80 N.-" 3.....	17	6	3	July 19, '15	21 00	"
1.00 N.-" 29.....	17	6	3	Aug. 2, '15	03	"
12.00 N.-" 19.....	17	6	3	" 2, '15	05	"
40.00 W.-" 11.....	18	6	3	Oct. 14, '15	27	C. M. Walker.
20.00 S.-" 9.....	17	7	3	" 3, '15	05	"
2.60 S.-" 24.....	18	7	3	" 13, '15	30	"
25.00 S.-" 30.....	44	7	3	" 22, '15	01	R. Neelands.
40.00 W.-" 24.....	44	7	3	" 22, '15	23	"
40.00 W.-" 31.....	15	8	3	Aug. 3, '15	04	G. C. Cowper.
40.00 S.-" 33.....	18	8	3	" 12, '15	35	"
10.00 S., 18.50 E.-NE. cor. sec. 5....	19	8	3	" 8, '15	32	"
4.00 S.-NE. cor. sec. 23.....	26	8	3	" 21, '15	05	S. L. Evans.
4.00 S.-" 24.....	26	8	3	" 24, '15	11	"
45.00 S.-" 22.....	26	8	3	" 25, '15	02	"
15.00 W.-SE. " 3.....	26	8	3	" 28, '15	30	"
15.00 S.-NE. " 21.....	26	8	3	Sept. 5, '15	29	"
6.00 N.-" 20.....	26	8	3	" 5, '15	26	"
27.00 S.-" 19.....	26	8	3	" 5, '15	29	"
At " 33.....	43	8	3	Oct. 13, '15	20 55	R. Neelands.
40.00 S.-" 23.....	44	8	3	" 9, '15	53	"
7.50 N.-" 28.....	44	8	3	" 16, '15	21 00	"
10.00 S.-" 24.....	26	9	3	Sept. 5, '15	24	S. L. Evans.
1.00 N.-" 23.....	26	9	3	" 8, '15	34	"
50.00 N.-" 7.....	26	9	3	" 14, '15	43	"
25.00 S.-" 20.....	26	9	3	" 14, '15	46	"
20.00 S.-" 21.....	26	9	3	" 14, '15	21 50	"
32.00 S.-" 34.....	26	9	3	" 17, '15	45	"
5.00 N.-" 4.....	16	10	3	Aug. 1, '15	27	G. C. Cowper.
5.00 N.-" 4.....	16	10	3	" 1, '15	29	"
At " 24.....	19	10	3	" 14, '15	19	"
1.00 N.-" 19.....	26	10	3	Sept. 29, '15	42	S. L. Evans.
10.00 S.-" 20.....	26	10	3	" 30, '15	42	"
25.00 S.-" 28.....	26	10	3	Oct. 3, '15	41	"
25.00 W.-" 32.....	26	10	3	" 7, '15	40	"
40.00 N.-" 6.....	46	10	3	June 7, '15	23 21	E. P. Bowman.
38.20 E., 7.00 N.-NE. cor. sec. 23....	13	12	3	July 27, '15	21 39	G. C. Cowper.
38.20 E.-7.00 N., NE. cor. sec. 23....	16	12	3	" 27, '15	45	"
40.00 N.-" 18.....	18	12	3	Aug. 24, '15	19	"
40.00 N.-" 18.....	18	12	3	" 24, '15	21	"
20.00 S.-" 19.....	57	12	3	Dec. 13, '14	24 45	W. J. Deans.
10.00 S.-" 28.....	16	14	3	Sept. 3, '15	20 45	G. C. Cowper.
10.00 S.-" 28.....	16	14	3	" 3, '15	45	"
1.00 S.-" 28.....	32	14	3	Oct. 5, '15	23 13	G. A. Bennett.
30.00 S.-" 14.....	36	14	3	May 3, '15	22	R. C. Purser
17.00 W.-" 33.....	36	14	3	" 5, '15	48	"
17.00 W.-" 33.....	36	14	3	" 6, '15	49	"
At $\frac{1}{4}$ cor. E. by sec. 8.....	36	14	3	" 17, '15	16	"
40.00 E.-NE. cor. sec. 32.....	39	14	3	June 15, '15	53	J. M. Côté.
30.00 W.-" 7.....	40	14	3	" 7, '15	44	"
30.00 W.-" 7.....	40	14	3	" 8, '15	49	"
At " 33.....	40	14	3	" 20, '15	24 04	"
25.00 N.-" 26.....	40	14	3	" 23, '15	30	"
45.50 W., 9.50 N.-NE. cor. sec. 33....	19	15	3	Sept. 16, '15	21 29	G. C. Cowper.
5.70 W., 36.00 S.-NE. cor. sec. 35....	19	15	3	" 17, '15	55	"
44.00 S.-NE. cor. sec. 32.....	19	1	3	" 20, '15	42	C. M. Walker
At " 10.....	35	15	3	May 7, '15	23 23	R. C. Purser.
At " 10.....	35	15	3	" 12, '15	27	"
At " 8.....	36	15	3	" 11, '15	24 08	"
6.00 S., 39.00 E.-NE. cor. sec. 30....	51	15	3	Aug. 10, '15	25 45	E. P. Bowman.
18.00 N., 6.00 E.-NE. cor. sec. 17....	51	15	3	" 10, '15	26 14	"
40.00 S.-" 6.....	51	15	3	" 26, '15	25 15	"
5.00 N., 13.00 W.-NE. cor. sec. 18....	52	15	3	Dec. 2, '15	27 32	"
8.27 N.- $\frac{1}{4}$ sec. cor. E. by sec. 24.....	52	15	3	" 3, '15	24 36	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
At NE. cor. sec. 19.....	12	16	3	June 20, '15	20 44	G. C. Cowper.
1-60 E.- " 31.....	15	16	3	July 12, '15	21 57	"
At " 19.....	17	16	3	" 15, '15	22 17	"
33-00 W.- " 33.....	17	16	3	Sept. 6, '15	12	"
15-00 S.- " 22.....	38	16	3	May 18, '15	23 53	R. C. Purser.
5-00 N.- " 2.....	38	16	3	" 19, '15	24 13	"
20-00 W.- " 11.....	38	16	3	" 30, '15	16	"
30-00 N., 28-00 E. NE. cor. sec. 20....	51	16	3	Aug. 2, '15	25 49	E. P. Bowman.
20-00 N.- " 22.....	61	16	3	Dec. 21, '14	38	W. J. Deans.
20-00 N.- " 22.....	61	16	3	" 23, '14	44	"
At " 35.....	61	16	3	" 28, '14	42	"
10-00 N.- " 34.....	61	16	3	" 29, '14	53	"
At ¼ sec. cor. N. by sec. 23.....	61	16	3	" 30, '14	44	"
40-00 N.-NE. cor. sec. 24.....	14	17	3	June 21, '15	21 32	G. C. Cowper.
40-00 N.- " 24.....	14	17	3	" 21, '15	30	"
40-00 W.- " 21.....	15	17	3	July 8, '15	50	"
12-00 N.- " 23.....	18	17	3	Sept. 10, '15	53	C. M. Walker.
31-00 N.- " 20.....	36	17	3	June 15, '15	24 53	G. A. Bennett.
39-00 N.-SE. " 3.....	37	17	3	" 7, '15	23 55	"
39-00 N.- " 3.....	37	17	3	" 10, '15	56	"
60-75 W.-NE. " 32.....	51	17	3	July 26, '15	25 50	E. P. Bowman.
6-32 W.- " 21.....	51	17	3	" 27, '15	26	"
15-00 W.- " 9.....	52	17	3	Sept. 4, '15	36	"
35-20 W.- " 33.....	11	18	3	" 29, '15	21 11	A. M. Narraway.
35-70 N.- " 12.....	12	18	3	" 30, '15	21 09	"
19-20 S.- " 23.....	12	18	3	Oct. 1, '15	16	"
At " 9.....	12	18	3	" 7, '15	22 18	"
1-00 E.- " 34.....	15	18	3	June 26, '15	17	G. C. Cowper.
1-00 E.- " 34.....	15	18	3	" 27, '15	17	"
1-00 E.- " 34.....	15	18	3	" 27, '15	18	"
1-00 E.- " 34.....	15	18	3	" 27, '15	21	"
1-00 E.- " 34.....	15	18	3	" 27, '15	25	"
1-00 E.- " 34.....	15	18	3	" 27, '15	25	"
1-00 E.- " 34.....	15	18	3	" 27, '15	21	"
1-00 E.- " 34.....	15	18	3	" 27, '15	19	"
1-00 E.- " 34.....	15	18	3	" 27, '15	19	"
1-00 E.- " 34.....	15	18	3	" 27, '15	21	"
1-00 E.- " 34.....	15	18	3	" 27, '15	18	"
46-00 S.- " 18.....	18	18	3	Oct. 21, '15	21 43	"
7-00 E., 33-00 N.-NE. cor. sec. 7....	22	18	3	" 8, '15	22 48	"
30-00 W., 24-00 S.-NE. cor. sec. 17....	22	18	3	" 15, '15	37	"
30-00 E.-NE. cor. sec. 34.....	31	18	3	" 3, '15	23	G. A. Bennett.
1-50 N., 45-50 E.-¼ sec. on E. by sec. 16.....	52	18	3	Sept. 14, '15	26 36	E. P. Bowman.
At NE. cor. sec. 35.....	72	18	3	April 6, '14	27 17	A. Saint Cyr.
At " 24.....	12	19	3	Sept. 28, '15	21 20	A. M. Narraway.
5-00 S.- " 36.....	18	19	3	" 16, '15	57	C. M. Walker.
26-00 S.- " 35.....	21	19	3	" 7, '15	22 37	A. M. Narraway.
8-00 N.- " 11.....	22	19	3	Aug. 30, '15	34	"
39-00 E.- " 8.....	22	19	3	Sept. 3, '15	19	"
24-00 S.- " 16.....	22	19	3	" 5, '15	21	"
24-70 S.- " 11.....	22	19	3	" 6, '15	32	"
34-10 E.- " 31.....	22	19	3	" 8, '15	08	"
21-50 W.- " 31.....	22	19	3	" 9, '15	03	"
38-50 S.- " 33.....	22	19	3	" 10, '15	15	"
11-00 W.-NE. cor. sec 34.....	22	19	3	" 10, '15	16	"
35-50 N.- " 26.....	22	19	3	Aug. 13, '15	30	"
At " 3.....	23	19	3	Sept. 14, '15	06	"
39-00 S.- " 9.....	23	19	3	" 16, '15	14	"
At " 21.....	50	19	3	July 7, '15	26 15	E. P. Bowman.
6-00 N.- " 10.....	51	19	3	" 20, '15	13	"
18-50 S., 3-75 E.-¼ cor. on E. by sec. 27.....	52	19	3	Sept. 20, '15	22	"
At NE. cor. sec. 35.....	8	20	3	July 10, '15	21 34	A. M. Narraway.
24-00 S.- " 31.....	9	20	3	" 6, '15	29	"
10-00 S.- " 12.....	49	20	3	June 28, '15	25 47	E. P. Bowman.

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—*Continued.*Table 1.—*Declination Observations.*—*Continued.*

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
27.00 S.-N.E. cor. sec. 4..	53	20	3	Sept. 23, '15	25 16	E. P. Bowman.
13.65 N., 36.70 E.-NE. cor. sec. 29..	54	20	3	Oct. 15, '15	24 42	"
13.65 N., 36.70 E.-NE. cor. sec. 29...	54	20	3	" 16, '15	41	"
3.40 E., 21.50 S.NE. cor. sec. 30..	6	21	3	June 6, '15	21 33	G. C. Cowper.
3.40 E., 21.50 S.- " 30	6	21	3	" 6, '15	31	"
At NE. cor. sec. 31.....	30	21	3	July 5, '15	53	J. M. Côté.
30.00 S.- " 21.....	30	21	3	" 6, '15	20 48	"
12.00 S., 37.25 E.-NE. cor. sec. 15....	52	21	3	Oct. 23, '15	24 40	E. P. Bowman.
40.00 N.-SE. cor. sec. 3.....	13	22	3	Aug. 17, '15	22 23	C. M. Walker.
35.00 N.-NE. " 12.....	16	22	3	" 12, '15	23 06	A. M. Narraway.
78.50 E.- " 32.....	16	22	3	" 14, '15	21 55	"
22.50 S.- " 29.....	16	22	3	" 17, '15	40	"
26.00 S.- " 16.....	16	22	3	" 18, '15	4	"
20.00 N.- " 20.....	47	22	3	May 16, '15	24 00	J. M. Côté.
At " 32.....	47	22	3	" 17, '15	23 28	"
52.00 N.- " 4.....	47	22	3	" 21, '15	24 57	"
20.00 N.-SE. " 2.....	47	22	3	" 25, '15	25 27	"
At " 4.....	47	22	3	" 28, '15	16	"
At " 6.....	47	22	3	" 29, '15	24 40	"
40.00 N.- " 3.....	47	22	3	" 30, '15	25 37	"
At NE. cor. sec. 34.....	47	22	3	Aug. 22, '15	24 09	R. C. Purser.
35.00 N.- " 34.....	47	22	3	" 23, '15	17	"
At " 36.....	12	23	3	July 19, '15	22 22	A. M. Narraway.
20.50 W.- " 36.....	12	23	3	" 21, '15	17	"
24.30 S.- " 33.....	12	23	3	" 21, '15	19	"
40.00 W.- " 32.....	12	23	3	" 21, '15	22	"
6.00 N.- " 13.....	13	23	3	" 19, '15	25	"
At " 36.....	16	23	3	Aug. 11, '15	23 30	"
21.00 N.- " 7.....	34	23	3	June 29, '15	17	G. A. Bennett.
28.00 E.- " 19.....	34	23	3	July 3, '15	24	"
13.00 S.- " 8.....	36	23	3	" 9, '15	29	"
12.00 S.- " 5.....	45	23	3	Aug. 17, '15	24 25	R. C. Purser.
10.00 E.- $\frac{1}{4}$ cor. N. by sec. 10.....	45	23	3	" 18, '15	29	"
At NE. cor. sec. 24.....	47	23	3	May 13, '15	23 29	J. M. Côté.
40.00 W.- " 31.....	51	23	3	April 27, '15	24 32	"
8.00 S.- " 28.....	51	23	3	May 2, '15	42	"
32.00 N.- " 14.....	51	23	3	" 4, '15	41	"
6.00 N.- " 26.....	51	23	3	" 6, '15	41	"
8.00 S.- " 28.....	51	23	3	" 8, '15	47	"
32.75 S.- $\frac{1}{4}$ cor. E. by sec. 1.....	51	23	3	Nov. 12, '15	37	E. P. Bowman.
10.00 N.-NE. cor. sec. 15.....	34	24	3	June 28, '15	23 21	G. A. Bennett.
43.00 W.-SE. " 2.....	35	24	3	July 2, '15	44	"
60.00 S.-NE. " 35.....	36	24	3	" 10, '15	47	"
19.00 S.- $\frac{1}{4}$ cor. E. by sec. 24.....	51	24	3	Nov. 6, '15	24 44	E. P. Bowman.
8.50 W.-NE. cor. sec. 11.....	11	25	3	May 6, '15	22 38	A. M. Narraway.
At " 11.....	11	25	3	" 7, '15	01	"
40.00 W.-SE. " 4.....	31	25	3	Sept. 6, '15	23 32	G. A. Bennett.
40.00 S.-NE. " 29.....	32	25	3	" 8, '15	24 06	"
At " 7.....	34	25	3	" 11, '15	12	"
3.00 N., 12.00 W.-NE. cor. sec. 27....	50	25	3	Oct. 28, '15	14	E. P. Bowman.
46.10 S.-NE. cor. sec. 22.....	13	26	3	June 15, '15	22 16	A. M. Narraway.
67.50 S.- " 15.....	13	26	3	" 16, '15	22 24	"
5.00 N.- " 16.....	13	26	3	" 16, '15	29	"
At " 19.....	13	26	3	" 18, '15	36	"
At " 7.....	13	26	3	" 18, '15	34	"
31.00 N.- " 5.....	35	26	3	July 15, '15	24 07	G. A. Bennett.
48.00 S.- " 24.....	35	26	3	" 22, '15	35	"
65.00 E.- " 20.....	36	26	3	" 26, '15	23 58	"
5.00 N.- " 23.....	27	27	3	" 10, '15	02	J. M. Côté.
15.00 S.- " 15.....	27	27	3	" 12, '15	10	"
35.00 N.- " 20.....	27	27	3	" 15, '15	39	"
10.00 S.- " 23.....	27	27	3	" 17, '15	04	"
2.00 N.-NW. " 30.....	27	27	3	" 19, '15	56	"
38.00 S.-NE. " 18.....	27	27	3	" 20, '15	38	"
17.00 E.- " 21.....	27	27	3	" 21, '15	26	"
46.00 N.- " 20.....	35	27	3	" 28, '15	24 12	G. A. Bennett

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.		Township.	Range.	Meridian.	Date.	Declination.	Observer.
						° /	
3.00 S.- cor. sec.	24	36	27	3	July 26, '15	24 03	G. A. Bennett.
40.00 S.-	36	31	28	3	Sept. 1, '15	00	"
At	27	31	28	3	" 3, '15	23 47	"
23.00 S.-	1	32	28	3	Aug. 27, '15	47	"
40.00 S.-	11	32	28	3	" 25, '15	41	"
47.50 S.-	21	34	28	3	" 11, '15	57	"
At	35	12	29	3	May 24, '15	22 43	A. M. Narraway.
At	34	12	29	3	" 25, '15	33	"
10.00 N.-	4	13	29	3	" 22, '15	29	"
25.75 N.-	14	13	29	3	" 24, '15	41	"
At	15	13	29	3	" 25, '15	37	"
At	17	14	29	3	June 8, '15	23 46	"
40.00 W.-	7	23	1	4	" 27, '15	24 13	O. B. Roberts.
5.00 N.-	20	24	1	4	" 14, '15	45	"
40.00 S.-	27	25	1	4	" 13, '15	43	"
7.00 S.-	26	27	1	4	" 1, '15	56	"
At	2	27	1	4	" 9, '15	59	"
40.00 S.-	12	28	1	4	May 30, '15	47	"
11.00 S.-	6	28	1	4	" 31, '15	04	"
40.00 E.-	31	30	1	4	Aug. 2, '15	23 34	"
40.00 S.-	8	30	1	4	" 2, '15	56	"
At	29	31	1	4	July 29, '15	12	"
At	6	31	1	4	" 30, '15	42	"
At	24	31	1	4	Aug. 3, '15	18	"
11.00 S.-	17	31	1	4	July 29, '15	22 47	"
At	36	32	1	4	Oct. 28, '15	21 27	R. B. McKay.
8.00 N.-	10	32	1	4	Aug. 11, '15	23 04	O. B. Roberts.
At	3	32	1	4	" 11, '15	04	"
40.00 S.-	34	32	1	4	" 12, '15	15	"
At	35	32	1	4	" 12, '15	20	"
At	23	32	1	4	" 12, '15	36	"
At	5	32	1	4	" 13, '15	10	"
40.00 S.-	17	33	1	4	" 7, '15	26 26	"
57.00 S.-	4	43	1	4	July 28, '15	24 35	G. W. Coltham.
1.00 N.-	21	44	1	4	Aug. 4, '15	33	E. S. Martindale.
5.00 W.- $\frac{1}{4}$ cor. N. by sec. 35		52	1	4	June 7, '15	26 07	R. C. Purser.
15.00 S.-NE. cor. sec. 34		52	1	4	" 8, '15	06	"
1.50 N.-	15	52	1	4	" 8, '15	25 53	"
10.00 S.- $\frac{1}{4}$ cor. E. by sec. 10		53	1	4	" 5, '15	26 01	"
10.00 S.-NE. cor. sec. 11		53	1	4	" 10, '15	01	"
15.00 E.-	9	53	1	4	" 11, '15	25 48	"
15.00 S.-	35	53	1	4	" 14, '15	27	"
61.27 W.-	32	104	1	4	May 24, '15	30 37	F. V. Seibert.
54.90 W.-	31	104	1	4	" 25, '15	35	"
At	23	20	2	4	Sept. 25, '15	23 09	R. C. Purser
20.00 W.-	36	28	2	4	July 25, '15	25 02	O. B. Roberts.
40.00 S.-	30	28	2	4	" 23, '15	24 15	"
At	35	29	2	4	" 31, '15	51	"
40.00 S.-	33	30	2	4	" 31, '15	40	"
At	6	31	2	4	Aug. 4, '15	25 03	"
40.00 S.-	16	32	2	4	" 17, '15	24 43	"
At	25	32	2	4	" 18, '15	23 58	"
9.78 S.-	3	32	2	4	" 19, '15	24 12	"
At	31	33	2	4	" 16, '15	33	"
At	8	33	2	4	" 17, '15	39	"
At SW.	6	23	3	4	July 9, '15	14	"
At NE.	5	23	3	4	Sept. 23, '15	22 44	"
3.25 W.-	7	24	3	4	July 5, '15	23 23	"
40.00 S.-	3	24	3	4	" 10, '15	37	"
40.00 S.-	26	25	3	4	" 7, '15	35	"
20.00 E.-	34	26	3	4	" 11, '15	24 41	"
13.00 S.-	21	30	3	4	Aug. 31, '15	34	"
3.00 S.-	24	32	3	4	" 26, '15	25 36	"
At	27	32	3	4	" 26, '15	52	"
55.00 S.-	17	32	3	4	" 27, '15	20	"
40.00 W.-	12	33	3	4	" 9, '15	42	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—*Continued.*Table 1.—Declination Observations.—*Continued.*

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
					° ' "	
At N.E. cor. sec. 1.....	33	3	4	Aug. 9, '15	25 46	O. B. Roberts.
40.00 S.-" 22.....	33	3	4	" 9, '15	26 28	"
At " 4.....	33	3	4	" 10, '15	36	"
At " 16.....	33	3	4	" 21, '15	06	"
At " 4.....	33	3	4	" 21, '15	15	"
10.00 S.-" 2.....	43	3	4	July 1, '15	24 17	R. C. Purser.
0.50 N.-" 36.....	44	3	4	Aug. 9, '15	28	E. S. Martindale.
45.00 E., 20.00 S.-NE. cor. sec. 19....	45	3	4	" 10, '15	26 15	"
At " 30.....	45	3	4	" 10, '15	25 47	"
At " 11.....	46	3	4	" 20, '15	27 07	"
At " 11.....	46	3	4	" 20, '15	12	"
4.00 S., 40.00 W.-NE. cor. sec. 4....	47	3	4	Aug. 31, '15	26 09	"
36.00 S.-NE. cor. sec. 6.....	47	3	4	Sept. 1, '15	25 53	"
4.00 S., 40.00 W.-NE. cor. sec. 4....	47	3	4	" 1, '15	26 14	"
25.53 W.-NE. cor. sec. 36.....	100	3	4	June 14, '14	30 09	F. V. Seibert.
At " 31.....	104	3	4	" 1, '15	12	"
40.00 N.-" 18.....	23	4	4	July 10, '15	23 42	O. B. Roberts.
At " 16.....	24	4	4	" 6, '15	28	"
At " 9.....	25	4	4	" 8, '15	34	"
40.00 S.-" 25.....	27	4	4	Sept. 3, '15	24 36	"
At " 9.....	27	4	4	" 3, '15	36	"
At " 21.....	27	4	4	" 4, '15	52	"
5.00 S.-" 18.....	27	4	4	" 4, '15	29	"
40.00 S.-" 2.....	28	4	4	" 7, '15	12	"
11.21 S.-" 31.....	28	4	4	" 7, '15	25 12	"
At " 7.....	44	4	4	July 12, '15	27 26	G. W. Coltham.
42.82 N.-" 24.....	45	4	4	Aug. 11, '15	25 38	E. S. Martindale.
27.60 E., 15.40 N.-NE. cor. sec. 21....	47	4	4	Sept. 3, '15	52	"
39.00 S.-NE. cor. sec. 14.....	24	5	4	" 28, '15	24 49	O. B. Roberts.
40.00 S.-" 19.....	25	5	4	" 16, '15	25	"
15.00 N.-" 20.....	26	5	4	" 15, '15	06	"
At " 32.....	26	5	4	" 15, '15	05	"
40.00 S.-" 26.....	27	5	4	" 8, '15	15	"
12.00 W.- $\frac{1}{4}$ cor. N. by sec. 33.....	28	5	4	July 20, '15	07	R. C. Purser.
Sta. 5, Barnes lake, sec. 1.....	44	5	4	" 3, '15	25 26	G. W. Coltham.
12.00 S.-NE. cor. sec. 19.....	45	5	4	June 10, '15	24 52	"
36.00 W.-" 10.....	45	5	4	" 18, '15	25 28	"
1.00 N.-" 20.....	46	5	4	Sept. 7, '15	29	E. S. Martindale.
20.00 S.- $\frac{1}{4}$ cor. E. by sec. 3.....	57	5	4	Aug. 28, '15	28	R. C. Purser.
13.50 N.-NE. cor. sec. 16.....	57	5	4	Sept. 1, '15	26 02	"
20.00 S.- $\frac{1}{4}$ cor. E. by sec. 4.....	58	5	4	" 8, '15	17	"
At NE. cor. sec. 31.....	104	5	4	June 5, '15	29 59	F. V. Seibert.
8.00 S.-" 30.....	23	6	4	Sept. 30, '15	24 33	O. B. Roberts.
36.47 S.-" 28.....	24	6	4	" 29, '15	08	"
30.00 N.-" 5.....	25	6	4	" 17, '15	05	"
3.27 N.-" 27.....	26	6	4	" 14, '15	02	"
At " 32.....	26	6	4	" 14, '15	23 55	"
28.75 S.-" 9.....	26	6	4	" 14, '15	58	"
11.48 S.-" 8.....	27	6	4	Oct. 25, '15	41	"
10.00 S.-" 24.....	45	6	4	June 11, '15	24 31	G. W. Coltham.
5.30 S., 8.00 W.-NE. cor. sec. 15....	47	6	4	Sept. 5, '15	25 25	E. S. Martindale.
10.00 N.-SE. cor. sec. 6.....	81	6	4	Oct. 12, '15	29 20	R. H. Knight.
At " 30.....	81	6	4	" 24, '15	24	"
At " 22.....	83	6	4	Sept. 30, '15	20	"
30.00 S.-" 14.....	83	6	4	Oct. 3, '15	13	"
At " 11.....	84	6	4	Sept. 20, '15	20	"
60.00 S.-" 2.....	84	6	4	" 28, '15	19	"
60.00 W.-" 32.....	100	6	4	June 29, '14	28 09	F. V. Seibert.
45.00 W.-" 32.....	104	6	4	" 7, '15	55	"
At " 3.....	23	7	4	Oct. 5, '15	23 53	O. B. Roberts.
16.00 N.-" 18.....	24	7	4	" 9, '15	50	"
61.00 W.-" 35.....	25	7	4	" 20, '15	43	"
2.65 S.-" 4.....	26	7	4	" 18, '15	41	"
48.31 S.-" 2.....	26	7	4	" 20, '15	47	"
24.27 N.-" 10.....	27	7	4	" 23, '15	24 00	"
40.00 S.-" 4.....	27	7	4	" 26, '15	23 51	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
At S.E. cor. sec. 35	44	7	4	June 7, '15	25 11	G. W. Coltham.
At " 11	47	7	4	Sept. 9, '15	32	E. S. Martindale.
Sta. 20, Traverse of lake Cote, in sec. 4	54	7	4	" 29, '15	26 07	"
At NE. cor. sec. 30	77	7	4	Nov. 11, '15	27 17	E. W. Hubbell.
40.00 N.-	85	7	4	Aug. 7, '15	29 11	R. H. Knight.
20.00 S.-	86	7	4	" 14, '15	02	"
40.00 W.-	86	7	4	" 14, '15	21	"
At " 16	86	7	4	Oct. 26, '15	29 51	E. W. Hubbell.
At " 33	87	7	4	June 21, '15	31	R. H. Knight.
20.00 S.-	87	7	4	" 28, '15	27	"
28.00 N.-	88	7	4	Oct. 20, '15	28 44	E. W. Hubbell.
At " 4	88	7	4	June 12, '15	29 17	R. H. Knight.
40.00 S.-	23	8	4	Oct. 2, '15	23 59	O. B. Roberts.
36.00 W.-	24	8	4	" 9, '15	55	"
33.18 N.-	24	8	4	" 9, '15	24 03	"
35.00 N.-	25	8	4	" 21, '15	23 39	"
0.40 N.-	47	8	4	Sept. 13, '15	25 21	E. S. Martindale.
2.20 N., 7.65 E.- $\frac{1}{4}$ cor. N. by sec. 22	53	8	4	" 23, '15	56	"
At SE. cor. sec. 3	55	8	4	Oct. 4, '15	26 26	"
0.70 S.-NE. " 19	55	8	4	" 9, '15	34	"
At " 27	76	8	4	Nov. 15, '15	30	E. W. Hubbell.
69.00 N.-SE. " 26	77	8	4	" 12, '15	28 51	"
34.33 W.-NE. " 35	104	8	4	June 11, '15	29 46	F. V. Seibert.
15.00 N.-	39	9	4	July 11, '15	24 43	R. C. Purser.
1.25 W.-M. at $\frac{1}{4}$ N. by sec. 36	52	9	4	Sept. 20, '15	26 17	E. S. Martindale.
3.00 S.-NE. cor. sec. 28	57	9	4	Oct. 14, '15	35	"
12.10 N.-	91	9	4	April 11, '15	30 08	L. E. Fontaine.
37.80 E.-SE. " 3	91	9	4	" 16, '15	28 57	"
65.00 E.-NE. " 17	99	9	4	Oct. 29, '15	29 00	J. W. Pierce.
45.00 E.-	99	9	4	Nov. 1, '15	17	"
32.50 W.-	100	9	4	July 9, '14	30 33	F. V. Seibert.
58.00 S.-	101	9	4	Oct. 7, '15	32 18	E. W. Hubbell.
79.00 W.-	104	9	4	June 16, '15	28 59	F. V. Seibert.
50.00 S.-	104	9	4	" 23, '15	29 34	"
13.00 N.-	105	9	4	" 17, '15	30 11	"
3.65 N., 3.00 E.-NE. cor. sec. 13	48	10	4	Sept. 14, '15	25 37	E. S. Martindale.
41.00 N.-NE. cor. sec. 15	57	10	4	Oct. 26, '15	26 08	"
At " 10	57	10	4	" 27, '15	19	"
Sta. 1, on lake Trav. in sec. 25	57	10	4	Nov. 1, '15	26 21	"
20.79 N.-NE. cor. sec. 25	91	10	4	April 26, '15	30 16	L. E. Fontaine.
50.00 N.-	98	10	4	June 24, '15	28 19	J. W. Pierce.
45.00 N.-	98	10	4	" 23, '15	26 37	"
73.00 S.-	99	10	4	Sept. 15, '15	30 22	"
36.00 W.-	99	10	4	" 17, '15	41	"
12.00 W.-	99	10	4	" 18, '15	29 34	"
45.00 S.-	99	10	4	Oct. 11, '15	03	"
48.00 E.-	99	10	4	" 26, '15	28 31	"
4.00 E.-SE. " 4	99	10	4	Nov. 3, '15	30 18	"
46.00 W.-NE. " 4	99	10	4	" 4, '15	29 21	"
12.00 S.-	100	10	4	Oct. 4, '15	30 19	"
80.70 W.-	100	10	4	July 17, '14	29 35	F. V. Seibert.
40.00 W.-	104	10	4	" 1, '15	31	"
2.00 N.-	60	11	4	Nov. 18, '15	26 53	E. S. Martindale.
75.00 N.-	94	11	4	Oct. 1, '15	30 51	E. W. Hubbell.
At " 15	96	11	4	" 4, '15	19	"
20.00 S.-	98	11	4	Sept. 29, '15	03	J. W. Pierce.
8.60 W.-	100	11	4	July 21, '14	34	F. V. Seibert.
43.73 W.-	100	11	4	" 24, '14	29 33	"
24.00 S.-	41	12	4	" 7, '15	24 43	R. C. Purser.
40.00 S.-	87	12	4	Mar. 26, '15	29 37	L. E. Fontaine.
40.00 W.-	100	12	4	July 30, '14	30 44	F. V. Seibert.
At " 30	42	13	4	Aug. 16, '14	25 23	O. B. Roberts.
On base line P. bet. lots 66 and 67, Lac La Biche settlement	67	13	4	Sept. 4, '15	27 38	P. R. A. Belanger.

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
41.00 N.-NE. cor. sec. 12, Lac La Biche settlement	67	13	4	Sept. 20, '15	27 27	P. R. A. Bélanger.
At NE. cor. sec. 9	68	13	4	" 26, '15	28 00	"
58.50 N.-" 23	87	13	4	Mar. 30, '15	11	L. E. Fontaine.
73.00 W.-" 34	100	13	4	Aug. 3, '14	31 13	F. V. Seibert.
At " 34	40	14	4	" 14, '14	25 22	O. B. Roberts.
3.00 E.-I. P. stone M. on lake shore bet. lots 50-51, Lac La Biche settlement	67	14	4	" 22, '15	28 13	P. R. A. Bélanger.
5.00 E.-P. placed on base line bet. lots 56 and 57, Lac La Biche settlement	67	14	4	" 27, '15	27 59	"
18.72 N.-NE. cor. sec. 14	87	14	4	April 1, '15	30 28	L. E. Fontaine.
3.00 S.- $\frac{1}{4}$ cor. on E. by sec. 1	31	15	4	July 19, '15	24 31	R. C. Purser.
5.00 E.-P. on base line between lots 11 and 12, Lac La Biche settlement	68	15	4	" 18, '15	28 31	P. R. A. Bélanger
At NE. cor. sec. 13	13	16	4	Sept. 16, '15	22 15	W. J. Boulton
7.62 E.-" 35	14	16	4	" 14, '15	58	"
2.00 N.- $\frac{1}{4}$ cor. E. by sec. 34	36	16	4	July 15, '15	24 59	R. C. Purser.
At $\frac{1}{4}$ cor. E. by sec. 19	53	16	4	Aug. 13, '15	26 14	"
9.22 N.-NE. cor. sec. 20	83	16	4	May 7, '15	31 10	L. E. Fontaine.
23.00 W.-" 32	100	16	4	Aug. 18, '14	32 34	F. V. Seibert.
65.00 W.-" 35	104	16	4	" 4, '15	33 04	"
25.00 W.-" 31	104	16	4	" 6, '15	32 48	"
41.00 N.-" 22	13	17	4	Sept. 15, '15	23 04	W. J. Boulton.
At " 31	13	17	4	" 15, '15	10	"
10.58 N., 54.55 E. NE. cor. sec. 1	33	17	4	Oct. 11, '15	24 14	R. C. Purser.
7.34 N.-NE. cor. sec. 8	79	17	4	May 25, '15	28 57	L. E. Fontaine.
4.81 S.-" 16	80	17	4	" 20, '15	30 45	"
40.98 S.-" 10	82	17	4	" 15, '15	12	"
1.00 S.-" 24	83	17	4	Mar. 10, '15	55	"
10.00 N.-" 11	84	17	4	May 12, '15	44	"
33.00 E.-" 8	58	18	4	Sept. 29, '15	26 57	H. M. R. Soars.
25.00 N.-" 23	59	18	4	" 20, '15	53	"
0.92 S.-SE. " 1	79	18	4	May 28, '15	29 33	L. E. Fontaine.
20.00 W.-NE. " 36	100	18	4	Aug. 24, '14	31 56	F. V. Seibert.
8.43 W.-" 33	100	18	4	" 25, '14	30 31	"
25.00 W.-" 33	104	18	4	" 19, '15	32 18	"
24.00 N.-" 5	7	19	4	June 22, '15	22 53	W. J. Boulton.
5.00 S., 17.00 E.-NE. cor. sec. 16	7	19	4	July 8, '15	22 44	"
At " 8	7	19	4	" 11, '15	55	"
7.50 E., 23.00 S.-" 10	11	19	4	Aug. 23, '15	47	"
36.00 W., 33.00 S.-" 30	12	19	4	Sept. 9, '15	21 59	"
At NE. cor. sec. 36	13	19	4	" 11, '15	54	"
33.00 E.-" 32	49	19	4	" 7, '15	26 24	H. M. R. Soars.
18.00 W.-" 11	52	19	4	July 27, '15	53	R. C. Purser.
50.00 E.-" 19	57	19	4	Oct. 9, '15	35	H. M. R. Soars.
At " 13	57	19	4	" 18, '15	45	"
5.00 E.-" 27	58	19	4	Sept. 27, '15	51	"
25.52 W.-" 31	100	19	4	Aug. 29, '14	31 53	F. V. Seibert.
40.00 N., 52.00 W.-NE. cor. sec. 8	7	20	4	July 12, '15	22 44	W. J. Boulton.
21.00 W., 34.00 N.-SE. " 5	7	20	4	June 29, '15	51	"
0.80 E., 6.50 N.-NE. " 9	8	20	4	July 3, '15	55	"
12.00 S., 19.50 E.-" 16	9	20	4	June 4, '15	23 09	"
2.50 E., 3.50 S.-" 21	12	20	4	Aug. 31, '15	05	"
40.00 N.-" 4	12	20	4	Sept. 6, '15	22 58	"
4.50 E., 6.50 S.-" 8	13	20	4	" 4, '15	23 12	"
54.00 W., 20.00 S.-" 18	14	20	4	" 22, '15	08	"
40.00 N.-NE. cor. sec. 15	14	20	4	" 24, '15	35	"
13.00 N.-" 33	49	20	4	Aug. 28, '15	26 32	H. M. R. Soars.
40.00 SW.-" 3	50	20	4	" 26, '15	26	"
20.00 NE.-" 17	50	20	4	" 30, '15	29	"
45.00 NW.-" 31	53	20	4	Oct. 28, '15	33	"
27.00 S.-" 2	70	20	4	Sept. 30, '15	28 07	H. E. Pearson.
27.00 S.-" 2	70	20	4	Oct. 4, '15	27 56	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
					° ' "	
15.00 W.-N.E. cor. sec. 29.....	72	20	4	Oct. 8, '15	28 45	H. E. Pearson.
15.00 N.-" 18.....	72	20	4	" 11, '15	29 27	"
10.00 S.-" 20.....	72	20	4	" 9, '15	16	"
10.00 N.-" 16.....	72	20	4	" 16, '15	18	"
18.00 S.-" 27.....	72	20	4	" 16, '15	18	"
20.00 N.-" 10.....	72	20	4	" 22, '15	28 59	"
35.30 W.-" 31.....	104	20	4	Sept. 1, '15	32 08	F. V. Seibert.
75.00 W., 5.00 S.-¼ sec. cor. E. by sec. 19.....	7	21	4	July 16, '15	22 50	W. J. Boulton.
67.10 W.-NE. cor. sec. 10.....	10	21	4	Aug. 15, '15	23 45	"
At " 34.....	12	21	4	Sept. 21, '15	22 41	"
40.00 W.-" 3.....	13	21	4	" 21, '15	23 28	"
41.00 N.-" 22.....	14	21	4	" 25, '15	23	"
15.00 S.-" 16.....	31	21	4	Oct. 3, '15	25 09	R. C. Purser.
26.00 W.-" 10.....	31	21	4	" 6, '15	49	"
15.00 SE.-" 8.....	49	21	4	Aug. 7, '15	26 30	H. M. R. Soars.
13.00 E.-¼ P. E. by sec. 15.....	49	21	4	" 14, '15	41	"
55.00 N.-NE. cor. sec. 13.....	49	21	4	" 20, '15	33	"
20.00 SE. " 29.....	50	21	4	Mar. 15, '15	16	"
15.00 N., 30.00 E.-NE. cor. sec. 16....	50	21	4	" 22, '15	46	"
40.00 N.W-NE. cor. sec. 21.....	50	21	4	" 25, '15	38	"
15.00 N.-" 8.....	50	21	4	April 4, '15	37	"
40.00 S.-" 6.....	50	21	4	Mar. 27, '15	34	"
25.00 S.-NW. " 7.....	50	21	4	" 27, '15	42	"
10.00 N., 40.00 W.-NE. cor. sec. 5....	53	21	4	Oct. 26, '15	27 12	"
46.00 E.-NE. cor. sec. 12.....	54	21	4	" 22, '15	26 58	"
At " 27.....	72	21	4	Aug. 25, '15	28 41	H. E. Pearson.
25.00 N.-" 32.....	72	21	4	" 28, '15	26	"
At " 31.....	72	21	4	" 30, '15	11	"
10.00 N.-" 17.....	72	21	4	Sept. 3, '15	33	"
60.00 N.-" 7.....	73	21	4	Aug. 11, '15	29	"
10.00 S.-" 29.....	73	21	4	" 14, '15	02	"
25.00 S.-" 35.....	73	21	4	" 20, '15	02	"
42.40 W.-" 33.....	104	21	4	Sept. 6, '15	31 20	F. V. Seibert.
16.50 W.-" 31.....	104	21	4	" 7, '15	30 45	"
32.00 N.-¼ cor. E. by sec. 17.....	31	22	4	Oct. 7, '15	25 00	R. C. Purser.
20.00 S.-NE. cor. sec. 21.....	48	22	4	July 22, '15	26 08	H. M. R. Soars.
40.00 NE.-" 10.....	48	22	4	" 29, '15	15	"
25.00 NE.-" 7.....	48	22	4	" 31, '15	16	"
40.00 NE.-" 7.....	48	22	4	" 31, '15	18	"
20.00 NW.-" 19.....	48	22	4	Aug. 2, '15	14	"
15.00 W.-" 23.....	49	22	4	July 15, '15	05	"
40.00 W.-" 31.....	49	22	4	" 15, '15	00	"
40.00 W.-" 18.....	50	22	4	June 15, '15	19	"
25.00 NW.-" 18.....	50	22	4	" 1, '15	11	"
20.00 E.-" 24.....	50	22	4	" 16, '15	09	"
At ¼ P.E. by sec. 28.....	50	22	4	" 18, '15	32	"
40.00 S.-NE. cor. sec. 28.....	50	22	4	" 18, '15	20	"
30.00 S.-" 8.....	50	22	4	" 23, '15	50	"
40.00 S.-" 16.....	50	22	4	" 22, '15	30	"
40.00 W.-" 9.....	50	22	4	" 21, '15	12	"
40.00 NW.-" 7.....	50	22	4	" 28, '15	02	"
38.00 S.-" 19.....	51	22	4	May 22, '15	14	"
25.00 S.-" 28.....	51	22	4	" 27, '15	28	"
At " 31.....	54	22	4	Nov. 6, '15	39	"
40.00 S.-" 19.....	73	22	4	July 19, '15	28 07	H. E. Pearson.
7.00 S.-" 27.....	73	22	4	" 27, '15	34	"
At " 21.....	73	22	4	" 27, '15	28	"
20.00 S.-" 26.....	73	22	4	Aug. 3, '15	55	"
17.00 S.-" 14.....	73	22	4	" 6, '15	31	"
56.00 E.-" 11.....	73	22	4	" 9, '15	38	"
20.00 SW.-" 18.....	48	23	4	July 7, '15	26 10	H. M. R. Soars.
40.00 W.-" 7.....	48	23	4	" 7, '15	10	"
20.00 S.-" 21.....	48	23	4	" 23, '15	25 59	"
40.00 NW.-" 7.....	49	23	4	" 2, '15	26 11	"
10.00 W.-" 23.....	49	23	4	" 10, '15	15	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—*Continued.*Table 1.—*Declination Observations.*—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
14.00 N.-N.E. cor. ecs. 13.....	49	23	4	July 2, '15	26 12	H. M. R. Soars.
10.00 W.- " 23.....	49	23	4	" 1, '15	10	"
20.00 SW.- " 5.....	49	23	4	" 8, '15	07	"
15.00 W.- " 23.....	49	23	4	" 12, '15	04	"
At " 30.....	50	23	4	June 8, '15	33	"
10.00 W.-SE. $\frac{1}{4}$ " 8.....	50	23	4	" 9, '15	24	"
25.00 E.-NE. " 8.....	51	23	4	May 31, '15	16	"
40.00 S.- " 1.....	54	23	4	Nov. 12, '15	45	"
8.00 E.- " 23.....	55	23	4	Aug. 6, '15	56	R. C. Purser.
55.00 E.- " 19.....	73	23	4	June 23, '15	29 24	H. E. Pearson.
40.00 N.- " 4.....	73	23	4	" 29, '15	13	"
60.00 N.- " 11.....	73	23	4	July 12, '15	28 36	"
33.14 S.- " 1.....	73	23	4	Sept. 5, '15	51	L. E. Fontaine.
22.00 W.- " 31.....	100	23	4	" 28, '14	31 24	F. V. Seibert.
1.50 W.- " 33.....	104	23	4	" 16, '15	28	"
6.00 W.-NW. " 31.....	104	23	4	" 18, '15	11	"
73.00 N.-NE. " 34.....	72	24	4	June 5, '15	30 00	H. E. Pearson.
1.50 S.- " 15.....	73	24	4	Aug. 30, '15	29 45	L. E. Fontaine.
20.00 E.- " 18.....	73	24	4	June 3, '15	28	H. E. Pearson.
At " 4.....	73	24	4	" 5, '15	48	"
55.00 N.- " 11.....	73	24	4	" 12, '15	43	"
46.00 E.- " 11.....	73	24	4	" 15, '15	19	"
60.00 W.- " 32.....	100	24	4	Oct. 5, '14	30 57	F. V. Seibert.
30.00 W.- " 33.....	104	24	4	Sept. 21, '15	31 25	"
1.26 N.- " 18.....	80	25	4	Jan. 8, '15	29 16	P. R. A. Bélanger.
5.00 N.-SE. " 2.....	1	26	4	July 25, '15	23 38	C. M. Walker.
20.00 E.-NE. " 21.....	81	26	4	Jan. 14, '15	29 11	P. R. A. Bélanger.
35.00 E., 12.50 N.- $\frac{1}{4}$ cor. E. by sec. 32.	18	29	4	Oct. 14, '15	24 24	W. J. Boulton.
19.50 E., 1.50 S.-NE. cor. sec. 35....	23	1	5	" 23, '15	24 58	"
15.40 E.-NE. cor. sec. 31.....	96	1	5	July 20, '15	30 50	J. A. Fletcher.
52.10 E.- " 34.....	96	1	5	" 22, '15	36	"
54.30 W.- " 35.....	92	2	5	Aug. 10, '15	44	"
59.50 E.- " 34.....	96	2	5	July 19, '15	33	"
20.00 NE. " 14.....	51	3	5	Nov. 26, '15	26 50	H. M. R. Soars.
At " 16.....	58	3	5	" 18, '15	57	"
10.00 N.- $\frac{1}{4}$ cor. E. by sec. 15.....	58	3	5	" 19, '15	59	"
At NE. cor. sec. 21.....	58	3	5	" 20, '15	58	"
At " 21.....	58	3	5	" 22, '15	34	"
35.00 NW.- " 15.....	58	3	5	" 22, '15	39	"
31.10 E.- " 32.....	96	3	5	July 13, '15	31 01	J. A. Fletcher.
4.00 N.- " 9.....	53	4	5	Aug. 3, '15	27 00	R. C. Purser.
9.30 E.- " 35.....	92	4	5	" 19, '15	31 31	J. A. Fletcher.
34.70 W.- " 34.....	92	5	5	" 27, '15	30 48	"
At " 31.....	108	5	5	Feb. 15, '15	32 41	P. M. H. LeBlanc.
5.00 W.- " 22.....	108	5	5	" 18, '15	34	"
18.50 N.- " 8.....	108	5	5	" 25, '15	03	"
2.00 N.- " 14.....	108	5	5	" 27, '15	31 29	"
2.00 N.- " 14.....	108	5	5	" 27, '15	31	"
2.00 N.- " 14.....	108	5	5	" 27, '15	31	"
28.00 N.- " 6.....	108	5	5	Mar. 17, '15	41	"
28.00 N.- " 6.....	108	5	5	" 17, '15	41	"
7.00 S.- " 4.....	65	6	5	July 12, '15	27 40	A. Lighthall.
1.84 S.- " 2.....	65	6	5	" 19, '15	51	"
75.00 N.- " 21.....	65	6	5	Aug. 1, '15	28 21	"
39.70 N.- " 3.....	65	6	5	July 13, '15	27 56	"
59.90 E.- " 10.....	65	6	5	" 20, '15	55	"
62.00 N.- " 30.....	65	6	5	" 28, '15	28 21	"
3.20 E.- " 35.....	65	6	5	" 30, '15	21	"
1.00 N.- " 28.....	76	6	5	Aug. 14, '15	30 53	G. J. Lonergan.
2.00 N.- " 17.....	77	6	5	" 13, '15	31 01	"
12.96 S.- " 4.....	63	7	5	Nov. 3, '15	27 38	L. E. Fontaine.
76.10 S.- " 21.....	63	7	5	Aug. 31, '15	23	A. Lighthall.
75.40 W.- " 30.....	63	7	5	Sept. 4, '15	33	"
3.20 N.- " 7.....	63	7	5	" 8, '15	24	"
58.60 W.- " 18.....	63	7	5	" 9, '15	26 43	"
27.60 E.- " 11.....	63	7	5	" 18, '15	27 49	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
80.20 S.-NE. cor. sec. 2	63	7	5	Sept. 20, '15	27 42	A. Lighthall.
20.00 S.-" 34	63	7	5	" 1, '15	17	"
18.00 N.-" 20	63	7	5	" 2, '15	14	"
70.10 S.-" 10	63	7	5	" 10, '15	23	"
71.70 S.-" 11	63	7	5	" 18, '15	42	"
42.80 S.-" 17	64	7	5	Aug. 23, '15	26 52	"
50.00 N.-" 31	64	7	5	June 9, '15	27 59	"
6.36 S.-" 32	64	7	5	" 18, '15	55	"
78.90 S.-" 7	64	7	5	Aug. 20, '15	05	"
0.87 N.-" 4	65	7	5	June 10, '15	28 14	"
6.77 N.-" 11	65	7	5	" 23, '15	14	"
At " 24	65	7	5	July 22, '15	15	"
21.00 W.-" 34	65	7	5	Aug. 10, '15	22	"
60.00 W.-" 33	65	7	5	" 11, '15	26	"
61.60 N.-" 27	65	7	5	" 6, '15	20	"
40.50 W.-" 19	65	7	5	" 10, '15	33	"
6.50 W.-" 31	92	7	5	Sept. 10, '15	29 54	J. A. Fletcher.
50.70 E.-" 36	96	7	5	June 25, '15	30 16	"
At " 16	61	8	5	Sept. 27, '15	27 30	A. Lighthall.
16.70 E.-" 11	61	8	5	" 30, '15	28 14	"
64.90 E.-" 18	61	8	5	Oct. 6, '15	27 57	"
28.80 E.-" 19	61	8	5	" 7, '15	06	"
75.60 N.-" 26	61	8	5	" 12, '15	56	"
70.10 E.-" 5	61	8	5	Sept. 30, '15	49	"
13.60 S.-" 34	61	8	5	Oct. 28, '15	44	L. E. Fontaine.
50.00 E.-" 9	62	8	5	" 16, '15	28 05	A. Lighthall.
77.40 E.-" 16	62	8	5	" 26, '15	27 26	"
52.90 E.-" 15	62	8	5	" 27, '15	30	"
74.70 N.-" 27	62	8	5	Nov. 3, '15	45	"
59.60 N.-" 6	62	8	5	Oct. 23, '15	26	"
47.40 E.-" 21	62	8	5	" 27, '15	30	"
44.70 N.-" 28	62	8	5	Nov. 5, '15	42	"
18.80 E.-" 34	96	8	5	June 21, '15	31 21	J. A. Fletcher.
60.00 N.-" 10	41	9	5	July 9, '15	27 44	A. L. Cumming.
15.00 N.-" 11	41	9	5	" 15, '15	44	"
At " 14	41	9	5	" 19, '15	34	"
60.00 N.-" 10	41	9	5	" 20, '15	43	"
25.00 E.-" 21	41	9	5	" 21, '15	39	"
48.00 W.-" 27	41	9	5	" 23, '15	37	"
43.00 N.-" 28	41	9	5	" 24, '15	31	"
34.00 N.-" 27	41	9	5	" 26, '15	40	"
55.00 N.-" 26	41	9	5	" 27, '15	34	"
72.00 E.-" 32	41	9	5	" 30, '15	31	"
60.00 W.-" 29	41	9	5	Aug. 3, '15	30	"
40.00 E.-" 20	41	9	5	" 5, '15	39	"
5.00 N.-" 30	41	9	5	" 6, '15	27	"
28.00 W.-" 19	41	9	5	" 9, '15	27	"
20.00 W.-" 18	41	9	5	" 16, '15	18	"
75.20 E.-" 12	61	9	5	Oct. 6, '15	26 56	A. Lighthall.
67.20 S.-" 25	63	9	5	Nov. 2, '15	27 41	"
52.30 S.-" 13	63	9	5	" 3, '15	05	"
49.10 S.-" 13	64	9	5	Oct. 31, '15	28 31	"
38.00 S.-" 1	64	9	5	Nov. 1, '15	06	"
37.43 E.-" 34	102	9	5	Aug. 28, '15	30 09	P. M. H. LeBlanc.
0.25 S.-" 36	102	9	5	" 29, '15	29 59	"
40.50 S.-NW. " 34	102	9	5	Sept. 7, '15	30 27	"
4.10 W.-SE. " 2	103	9	5	" 13, '15	05	"
4.35 W.-" 2	103	9	5	" 28, '15	07	"
51.33 E.-NE. " 10	103	9	5	Sept. 4, '15	28	"
10.25 N.- $\frac{1}{4}$ sec. cor. S. by sec. 2	103	9	5	" 5, '15	18	"
24.80 N.-NE. cor. sec. 12	104	9	5	Aug. 19, '15	31 11	"
69.75 S.-" 1	104	9	5	" 22, '15	09	"
25.00 W.-" 35	39	10	5	Sept. 29, '15	27 20	A. L. Cumming.
At " 23	39	10	5	Oct. 22, '15	21	"
At " 14	39	10	5	" 23, '15	08	"
At " 14	39	10	5	" 23, '15	10	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—*Continued.*Table 1.—*Declination Observations.*—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
49.53 W.-N.E. cor. sec. 35	39	10	5	Oct. 30, '15	27 24	A. L. Cumming.
23.25 S.-	40	10	5	" 28, '15	19	"
At " 4	41	10	5	June 4, '15	18	"
At " 16	41	10	5	" 7, '15	11	"
10.00 E.-	41	10	5	" 8, '15	15	"
25.00 E.-	41	10	5	" 10, '15	25	"
15.00 W.-	41	10	5	" 11, '15	26	"
18.00 N.-	41	10	5	" 12, '15	04	"
25.00 N.-	41	10	5	" 14, '15	20	"
60.00 N.-	41	10	5	" 15, '15	24	"
20.00 N.-	41	10	5	May 22, '15	34	"
32.00 N.-	41	10	5	" 24, '15	24	"
30.00 N.-	41	10	5	" 26, '15	27	"
35.00 N.-	41	10	5	" 27, '15	28	"
4.00 W.-	41	10	5	" 29, '15	21	"
63.00 E.-	41	10	5	June 1, '15	29	"
10.00 W.-	41	10	5	" 1, '15	22	"
At " 15	41	10	5	" 3, '15	21	"
10.00 W.-	41	10	5	" 18, '15	28	"
57.00 W.-	41	10	5	" 21, '15	14	"
5.00 W.-	41	10	5	" 22, '15	17	"
5.00 W.-	41	10	5	" 23, '15	11	"
34.00 E.-	41	10	5	Aug. 13, '15	21	"
30.00 W.-	41	10	5	" 17, '15	22	"
3.00 S.-	41	10	5	" 21, '15	15	"
16.00 W.-	41	10	5	" 21, '15	10	"
66.70 W.-	92	10	5	Sept. 22, '15	31 32	J. A. Fletcher.
32.00 E.-	96	10	5	June 3, '15	26	"
35.10 N.-	101	10	5	July 31, '15	30 51	P. M. H. LeBlanc.
9.50 N.-	101	10	5	" 31, '15	54	"
21.40 S.-	101	10	5	Aug. 4, '15	31 10	"
38.20 N.-	102	10	5	" 7, '15	32 00	"
35.00 S.-	103	10	5	July 21, '15	30 59	"
35.70 S.-	104	10	5	June 30, '15	31 38	"
At " 35	108	10	5	Mar. 27, '15	14	"
5.00 N.-	109	10	5	April 1, '15	28	"
30.00 S.-	40	11	5	Aug. 27, '15	27 21	A. L. Cumming.
45.00 E.-	40	11	5	" 28, '15	23	"
45.00 W.-	40	11	5	" 30, '15	21	"
22.00 N.-	40	11	5	" 31, '15	20	"
25.00 E.-	40	11	5	Sept. 2, '15	12	"
72.00 S.-	40	11	5	" 6, '15	19	"
65.00 W.-	40	11	5	" 7, '15	21	"
15.00 W.-	40	11	5	" 8, '15	16	"
35.00 E.-	40	11	5	" 10, '15	17	"
32.00 E.-NW.	40	11	5	" 16, '15	13	"
30.00 E.-NE.	40	11	5	" 18, '15	18	"
At " 15	40	11	5	" 20, '15	17	"
20.00 S.-	40	11	5	" 21, '15	16	"
50.00 S.-	40	11	5	" 24, '15	13	"
70.00 S.-	40	11	5	" 25, '15	14	"
9.00 N.-SE.	40	11	5	" 28, '15	25	"
30.00 S.-NE.	41	11	5	" 14, '15	15	"
10.00 E.-	41	11	5	Aug. 18, '15	20	"
45.00 N.-	41	11	5	" 19, '15	20	"
35.00 N.-	41	11	5	" 23, '15	15	"
38.00 E.-	41	11	5	" 24, '15	19	"
60.20 W.-	92	11	5	Sept. 29, '15	30 31	J. A. Fletcher.
39.00 W.-	92	11	5	" 20, '15	23	"
2.50 S.-	108	11	5	May 16, '14	32 41	P. M. H. LeBlanc.
50.00 N.-	108	11	5	Oct. 8, '14	48	"
At " 20	109	11	5	Feb. 3, '15	34 01	"
43.00 W.-	92	12	5	Oct. 2, '15	30 29	J. A. Fletcher.
17.00 W.-	92	12	5	" 6, '15	31 18	"
19.40 E.-	96	12	5	May 22, '15	30 13	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
0-14 S.-N.E. cor. sec. 11.....	108	12	5	May 9, '14	32 14	P. M. H. LeBlanc.
At 16.....	109	12	5	Jan. 12, '15	34 55	"
10-00 S.- " 22.....	109	12	5	" 15, '15	49	"
At 14.....	109	12	5	" 16, '15	58	"
8-00 N.- " 22.....	109	12	5	April 6, '15	47	"
60-00 S.- " 28.....	72	13	5	Oct. 22, '15	29 26	D. F. McEwen.
Sta. 22 of trav. in sec. 25.....	72	13	5	Nov. 8, '15	27	"
10-00 S.-NE. cor. sec. 29.....	72	13	5	Oct. 16, '15	26	"
10-00 S.- " 20.....	72	13	5	" 18, '15	26	"
10-00 E.- " 21.....	72	13	5	" 21, '15	21	"
49-00 S.- " 22.....	72	13	5	" 27, '15	06	"
21-70 W.- " 32.....	92	13	5	" 12, '15	31 36	J. A. Fletcher.
47-40 E.- " 33.....	96	13	5	May 18, '15	29 23	"
At 2.....	71	14	5	Oct. 13, '15	30	D. F. McEwen.
6-00 N.-SE. " 3.....	71	14	5	" 12, '15	40	"
50-00 E.-NE. " 31.....	71	14	5	Sept. 28, '15	33	"
30-00 S.- " 33.....	71	14	5	" 29, '15	36	"
35-00 S.- " 17.....	71	14	5	Oct. 2, '15	18	"
8-00 W.- " 8.....	71	14	5	" 5, '15	15	"
65-00 S.- " 28.....	71	14	5	" 6, '15	30	"
60-00 S.- " 27.....	71	14	5	" 7, '15	29	"
At 10.....	71	14	5	" 8, '15	28	"
Sta. 62 of trav. in sec. 19.....	71	14	5	Nov. 22, '15	49	"
20-00 E.-NE. cor. sec. 6.....	71	14	5	Sept. 29, '15	36	"
5-00 W.-NE. cor. sec. 20.....	71	14	5	Oct. 1, '15	29 46	"
4-00 S.- " 7.....	71	14	5	" 2, '15	46	"
20-00 W.- " 18.....	71	14	5	" 5, '15	42	"
10-00 W.- " 16.....	71	14	5	" 6, '15	39	"
25-00 S.- " 21.....	71	14	5	" 7, '15	38	"
35-00 S.- " 4.....	71	14	5	" 11, '15	40	"
30-00 E.- " 22.....	71	14	5	" 12, '15	44	"
30-00 S.- " 23.....	71	14	5	" 13, '15	34	"
72-00 S.- " 25.....	72	14	5	" 20, '15	19	"
9-20 W.- " 34.....	92	14	5	" 15, '15	30 52	J. A. Fletcher.
30-00 E.- " 8.....	104	14	5	Aug. 28, '14	32 39	P. M. H. LeBlanc.
29-00 S.- " 22.....	107	14	5	May 28, '14	34 17	"
At 7.....	107	14	5	June 10, '14	12	"
10-00 S.- $\frac{1}{4}$ sec. cor. E. by sec. 6.....	107	14	5	Sept. 25, '14	02	"
50-00 N.-NE. cor. sec. 20.....	108	14	5	" 23, '15	19	"
30-00 W.-SE. " 7.....	26	15	5	July 27, '15	26 16	N. C. Stewart.
40-00 W.-SE. " 17.....	26	15	5	" 30, '15	01	"
30-00 S.-NE. " 24.....	71	15	5	" 26, '15	29 38	D. F. McEwen.
Sta. 75 of trav. in sec. 25.....	71	15	5	Nov. 23, '15	46	"
Sta. 96 " 35.....	71	15	5	" 24, '15	51	"
Sta. 112 " 35.....	71	15	5	" 25, '15	50	"
15-00 N.-NE. cor. sec. 9.....	71	15	5	Sept. 21, '15	34	"
25-00 N.- " 13.....	71	15	5	" 25, '15	29	"
30-00 N.- " 1.....	71	15	5	" 27, '15	34	"
20-00 E.- " 12.....	71	15	5	Oct. 4, '15	43	"
42-50 E.- " 15.....	71	15	5	Sept. 22, '15	43	"
60-00 S.- " 33.....	72	15	5	Aug. 20, '15	30 05	"
50-00 S.- " 3.....	72	15	5	Sept. 8, '15	29 51	"
Sta. 144 of trav. in sec. 10.....	72	15	5	Nov. 27, '15	48	"
Sta. 164 " 15.....	72	15	5	" 29, '15	50	"
Sta. 221 " 32.....	72	15	5	Dec. 3, '15	36	"
53-50 W.-NE. cor. sec. 35.....	92	15	5	Oct. 19, '15	31 02	J. A. Fletcher.
42-10 E.- " 32.....	96	15	5	May 7, '15	30 33	"
25-70 E.- " 36.....	96	15	5	" 10, '15	56	"
15-60 W.- " 35.....	105	15	5	July 11, '14	34 15	P. M. H. LeBlanc.
2-00 N.- " 25.....	106	15	5	Sept. 18, '15	08	"
30-00 N.- " 20.....	106	15	5	Aug. 23, '14	33 30	"
20-00 S.- " 3.....	107	15	5	Oct. 10, '14	35 51	"
10-00 N.- " 17.....	108	15	5	Dec. 19, '14	34 31	"
At 21.....	108	15	5	" 28, '14	41	"
20-00 N.- " 14.....	108	15	5	Jan. 4, '15	40	"
12-50 N.-SE. " 4.....	25	16	5	July 5, '15	26 18	N. C. Stewart.

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—*Continued.*Table 1.—*Declination Observations.*—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
51.00 E.-NE. cor. sec. 4.	25	16	5	July 7, '15	26 30	N. C. Stewart.
At SW. " 26.	25	16	5	" 16, '15	27	"
62.00 E.-NE. " 22.	25	16	5	" 17, '15	32	"
5.00 S.- " 26.	25	16	5	" 20, '15	25 55	"
At " 35.	25	16	5	" 22, '15	26 01	"
29.00 W.-SE. " 1.	26	16	5	" 15, '15	04	"
At NE. " 1.	26	16	5	" 26, '15	25 54	"
4.00 S.- " 1.	26	16	5	" 29, '15	26 28	"
0.50 S.- " 31.	71	16	5	Sept. 24, '15	29 07	L. E. Fontaine.
At " 34.	71	16	5	Aug. 4, '15	40	D. F. McEwen.
25.00 S.- " 30.	71	16	5	" 5, '15	32	"
At " 6.	72	16	5	July 11, '15	12	"
At " 6.	72	16	5	" 11, '15	05	"
At " 13.	72	16	5	Sept. 20, '15	35	L. E. Fontaine.
25.00 W.- " 36.	92	16	5	Oct. 21, '15	31 32	J. A. Fletcher.
0.60 N.- " 36.	105	16	5	July 20, '14	34 50	P. M. H. LeBlanc.
20.00 S.- " 13.	106	16	5	" 20, '14	38	"
25.00 S.- " 33.	108	16	5	Oct. 15, '14	21	"
At " 24.	108	16	5	" 15, '14	39	"
At " 12.	24	17	5	June 14, '15	25 41	N. C. Stewart.
22.00 E.- " 12.	24	17	5	" 15, '15	26 18	"
At " 12.	24	17	5	" 22, '15	25 27	"
30.00 E.- " 19.	71	17	5	July 1, '15	29 23	D. F. McEwen.
5.00 W.- " 29.	72	17	5	June 9, '15	21	"
Sta. 46 of trav. in sec. 28.	72	17	5	Dec. 7, '15	31	"
8.40 N.-NE. cor. sec. 23.	72	17	5	Sept. 26, '15	24	L. E. Fontaine.
33.60 W.- " 36.	92	17	5	Oct. 25, '15	31 13	J. A. Fletcher.
65.30 W.- " 33.	92	17	5	" 29, '15	04	"
52.80 E.- " 35.	96	17	5	May 2, '15	33 03	"
1.00 S.- " 23.	108	17	5	Oct. 31, '14	34 59	P. M. H. LeBlanc.
1.00 S.- " 23.	108	17	5	" 31, '14	58	"
1.00 S.- " 23.	108	17	5	" 31, '14	35 01	"
1.00 S.- " 23.	108	17	5	" 31, '14	04	"
29.00 E.- " 9.	108	17	5	Nov. 6, '14	19	"
32.50 S.- " 19.	108	17	5	" 17, '14	34 21	"
56.10 N.- " 10.	109	17	5	April 12, '15	33 19	"
56.10 N.- " 10.	109	17	5	" 13, '15	14	"
2.75 N.- $\frac{1}{4}$ cor. E. by sec. 31.	109	17	5	May 26, '15	32 16	"
1.50 S.- " 36.	109	17	5	" 30, '15	33 15	"
73.00 S.-NE. cor. sec. 12.	72	18	5	June 24, '15	29 31	D. F. McEwen.
5.00 S.- " 26.	108	18	5	Nov. 20, '14	33 34	P. M. H. LeBlanc.
3.50 N.-SE. " 1.	109	18	5	April 24, '15	30	"
3.50 N.- " 1.	109	18	5	" 23, '15	52	"
3.50 N.- " 1.	109	18	5	" 25, '15	25	"
3.50 N.- " 1.	109	18	5	" 26, '15	32 33	"
22.00 N.-NE. " 28.	109	18	5	May 17, '15	33 14	"
At " 31.	109	18	5	" 12, '15	32 42	"
20.30 S.- " 27.	82	19	5	" 12, '15	30 24	J. H. Johnston.
15.60 N.- " 25.	82	19	5	" 13, '15	23	"
10.00 N.- " 28.	82	19	5	" 14, '15	15	"
50.00 E.- " 35.	82	19	5	" 27, '15	32	"
60.00 N.- " 2.	83	19	5	" 31, '15	25	"
60.00 N.- " 11.	83	19	5	June 3, '15	35	"
44.00 N.- " 15.	83	19	5	" 12, '15	24	"
At " 34.	83	19	5	" 23, '15	49	"
At " 8.	83	19	5	Oct. 25, '15	41	G. J. Lonergan.
45.00 E.- " 18.	84	19	5	" 28, '15	31	"
30.00 E.- " 10.	84	19	5	June 24, '15	41	J. H. Johnston.
48.00 N.- " 10.	84	19	5	" 25, '15	53	"
20.00 E.- " 16.	84	19	5	" 26, '15	39	"
48.00 N.- " 9.	84	19	5	" 28, '15	38	"
15.00 S.- " 9.	85	19	5	July 18, '15	08	"
12.00 W.- " 8.	85	19	5	" 9, '15	25	"
60.00 N.- " 5.	85	19	5	" 13, '15	04	"
At " 20.	85	19	5	" 27, '15	17	"
At " 23.	85	19	5	" 29, '15	19	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
10.00 S.-N.E. cor. sec. 31.....	85	19	5	Aug. 3, '15	30 24	J. H. Johnston.
15.00 S.- " 5.....	85	19	5	Oct. 29, '15	45	G. J. Lonergan.
5.80 E.- " 14.....	86	19	5	Aug. 18, '15	35	J. H. Johnston.
At " 31.....	86	19	5	Sept. 25, '15	40	"
10.40 W.- " 36.....	86	19	5	" 28, '15	41	"
36.20 S.- " 29.....	87	19	5	" 8, '15	31 07	"
39.00 W.- " 19.....	87	19	5	" 9, '15	08	"
55.20 S.- " 28.....	87	19	5	" 10, '15	11	"
30.65 S.- " 25.....	108	19	5	Dec. 5, '14	33 26	P. M. H. Le Blanc.
20.00 S.- " 28.....	26	20	5	May 19, '15	25 48	N. C. Stewart.
10.00 E.- " 21.....	26	20	5	" 20, '15	52	"
47.50 E.- " 21.....	26	20	5	" 25, '15	56	"
Sta. 27 in sec. 26.....	26	20	5	" 26, '15	57	"
Sta. 1 S.-NE. cor. sec. 28.....	26	20	5	June 3, '15	48	"
Sta. 38 in sec. 24.....	26	20	5	" 4, '15	51	"
0.10 N.-NE. cor. sec. 29.....	71	20	5	Oct. 10, '15	30 35	L. E. Fontaine.
19.00 E.-NE. " 31.....	71	20	5	July 26, '15	31 01	A. E. Glover.
19.00 E.- " 30.....	71	20	5	" 29, '15	30 46	"
10.00 S.-NE. " 25.....	71	20	5	Sept. 6, '15	31 01	"
20.00 S.- " 3.....	71	20	5	Oct. 6, '15	30 04	"
29.70 E.- " 22.....	72	20	5	" 6, '15	19	L. E. Fontaine.
10.00 S.- " 26.....	72	20	5	May 10, '15	34	A. E. Glover.
At " 13.....	72	20	5	" 13, '15	47	"
15.00 E.- " 12.....	72	20	5	" 21, '15	43	"
At " 33.....	72	20	5	" 31, '15	18	"
At " 29.....	72	20	5	June 4, '15	08	"
10.00 N.- " 18.....	72	20	5	" 7, '15	02	"
At " 9.....	72	20	5	Aug. 28, '15	18	"
38.00 E.- " 4.....	72	20	5	" 30, '15	24	"
2.00 N.- " 4.....	72	20	5	" 31, '15	15	"
32.00 S.- " 2.....	72	20	5	Sept. 2, '15	33	"
5.00 S.- " 1.....	72	20	5	" 4, '15	51	"
21.50 N.- " 23.....	84	20	5	Oct. 1, '15	36	J. H. Johnston.
10.80 S.- " 15.....	84	20	5	" 8, '15	46	"
15.20 N.- " 9.....	84	20	5	" 11, '15	48	"
At " 19.....	84	20	5	" 26, '14	43	A. L. Cumming.
75.00 N.- " 7.....	85	20	5	Jan. 31, '15	56	L. E. Fontaine.
9.48 N.- " 10.....	86	20	5	Feb. 10, '15	31 04	"
14.87 N.-SE. " 2.....	87	20	5	" 13, '15	30 50	"
2.00 E.-NE. " 33.....	91	20	5	Sept. 3, '15	32 12	J. A. Buchanan.
2.00 N.- " 15.....	91	20	5	" 10, '15	10	"
60.00 W.- " 27.....	91	20	5	" 11, '15	13	"
50.00 W.- " 22.....	91	20	5	" 14, '15	17	"
38.00 W.- " 25.....	91	20	5	" 15, '15	15	"
60.00 W.- " 13.....	91	20	5	" 20, '15	23	"
50.00 W.- " 3.....	91	20	5	" 24, '15	10	"
65.00 W.- " 12.....	91	20	5	" 27, '15	24	"
30.00 S.-NE. cor. sec. 17.....	92	20	5	Aug. 20, '15	38	"
35.00 W.- " 14.....	92	20	5	" 28, '15	39	"
50.00 S.- " 17.....	92	20	5	" 30, '15	11	"
60.00 W.- " 22.....	92	20	5	" 23, '15	27	"
35.00 W.- " 4.....	92	20	5	Sept. 1, '15	16	"
75.00 S.- " 3.....	92	20	5	" 4, '15	19	"
22.00 E.- " 9.....	27	21	5	April 23, '15	26 24	N. C. Stewart.
Point A, S.-NE. cor. sec. 1.....	27	21	5	May 6, '15	25 44	"
10.00 W.-NE. cor. sec. 1.....	27	21	5	" 12, '15	54	"
1.40 S.- " 1.....	71	21	5	Oct. 11, '15	30 00	L. E. Fontaine.
10.00 E.- " 31.....	71	21	5	July 7, '15	29 54	A. E. Glover.
20.00 E.- " 33.....	71	21	5	" 9, '15	30 40	"
25.00 W.- " 35.....	71	21	5	" 12, '15	15	"
40.00 W.- " 35.....	71	21	5	" 14, '15	10	"
10.00 W.- " 26.....	71	21	5	" 16, '15	41	"
30.00 W.- " 27.....	71	21	5	" 17, '15	42	"
20.00 N.- " 27.....	71	21	5	" 19, '15	29 36	"
At " 22.....	71	21	5	" 20, '15	30 35	"
30.00 S.- " 26.....	71	21	5	" 21, '15	42	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
					° ' "	
40.00 S.-N-E. cor. sec. 23.....	71	21	2 5	July 2, '15	30 38	A. E. Glover.
50.00 S.-" 29.....	71	21	5	" 24, '15	29 59	"
20.00 S.-" 36.....	71	21	5	" 27, '15	30 23	"
24.00 N.-" 25.....	71	21	5	" 28, '15	07	"
10.00 W.-" 21.....	71	21	5	" 31, '15	39	"
6.00 N.-" 14.....	71	21	5	Aug. 2, '15	29 56	"
5.00 N.-" 13.....	71	21	5	" 3, '15	30 44	"
At " 13.....	71	21	5	" 4, '15	29 50	"
15.00 N.-" 11.....	71	21	5	" 6, '15	30 39	"
27.00 S.-" 11.....	71	21	5	" 7, '15	29 54	"
28.00 E.-" 15.....	71	21	5	" 9, '15	57	"
10.00 E.-" 11.....	71	21	5	" 13, '15	30 38	"
10.00 N.-" 3.....	71	21	5	" 14, '15	43	"
20.00 E.-" 4.....	71	21	5	" 16, '15	29 51	"
29.00 E.-SW.-" 6.....	71	21	5	" 17, '15	30 33	"
20.00 W.-SE. " 6.....	71	21	5	" 18, '15	29 50	"
30.00 E.-" 6.....	71	21	5	" 19, '15	30 22	"
39.00 W.-NE. " 3.....	71	21	5	" 23, '15	41	"
40.00 E.-" 3.....	71	21	5	" 24, '15	38	"
21.00 W.-" 1.....	71	21	5	" 25, '15	29	"
40.00 S.-" 24.....	72	21	5	June 9, '15	21	"
10.00 N.-" 23.....	72	21	5	" 12, '15	32	"
55.00 S.-" 13.....	72	21	5	" 14, '15	31 02	"
10.00 N.-" 1.....	72	21	5	" 15, '15	30 51	"
25.00 S.-" 14.....	72	21	5	" 18, '15	31 01	"
20.00 N.-" 2.....	72	21	5	" 19, '15	00	"
10.00 N.-" 27.....	72	21	5	" 21, '15	30 40	"
60.00 E.-" 26.....	72	21	5	" 22, '15	44	"
At " 22.....	72	21	5	" 23, '15	31	"
45.00 S.-" 22.....	72	21	5	" 24, '15	36	"
5.00 N.-" 10.....	72	21	5	" 25, '15	44	"
5.00 S.-" 10.....	72	21	5	" 26, '15	42	"
12.00 S.-" 18.....	72	21	5	July 1, '15	09	"
20.00 N.-" 18.....	72	21	5	June 30, '15	29 56	"
30.00 S.-" 7.....	72	21	5	July 3, '15	30 19	"
10.00 S.-" 6.....	72	21	5	" 5, '15	02	"
At " 22.....	82	21	5	June 18, '14	18	A. L. Cumming.
60.00 N.-" 9.....	82	21	5	" 23, '14	09	"
20.00 W.-" 9.....	82	21	5	" 25, '14	29 59	"
40.00 N.-" 29.....	82	21	5	July 2, '14	30 29	"
60.00 N.-" 19.....	82	21	5	" 13, '14	47	"
8.00 W.-" 35.....	82	21	5	" 29, '14	02	"
70.00 W.-" 20.....	82	21	5	Aug. 5, '14	24	"
56.00 W.-" 9.....	82	21	5	" 6, '14	03	"
6.00 E.-SE. " 3.....	83	21	5	" 1, '14	09	"
15.00 N.-NE. " 11.....	85	21	5	Jan. 30, '15	31 14	L. E. Fontaine.
10.70 N.-" 9.....	86	21	5	Feb. 3, '15	35	"
23.48 N.-SE. " 3.....	87	21	5	" 4, '15	34	"
70.00 E.-NW. " 4.....	90	21	5	July 26, '15	01	G. J. Lonergan.
60.00 N.-SE. " 1.....	90	21	5	May 17, '15	32 32	J. A. Buchanan.
35.00 S.-NE. " 21.....	90	21	5	" 19, '15	15	"
10.00 S.-" 13.....	90	21	5	" 22, '15	28	"
20.00 N.-" 15.....	90	21	5	" 26, '15	26	"
30.00 W.-" 24.....	90	21	5	" 28, '15	09	"
30.00 S.-" 17.....	90	21	5	June 1, '15	18	"
45.00 W.-" 15.....	90	21	5	" 4, '15	14	"
15.00 S.-" 13.....	91	21	5	" 15, '15	27	"
75.00 S.-" 12.....	91	21	5	" 16, '15	33	"
10.00 S.-" 4.....	91	21	5	" 24, '15	11	"
5.00 S.-" 5.....	91	21	5	" 28, '15	19	"
30.00 S.-" 6.....	91	21	5	" 30, '15	25	"
35.00 S.-" 7.....	91	21	5	July 1, '15	13	"
30.00 E.-" 22.....	91	21	5	" 29, '15	31 53	G. J. Lonergan.
30.00 S.-" 6.....	92	21	5	" 30, '15	32 21	J. A. Buchanan.
2.00 S.-" 8.....	92	21	5	Aug. 2, '15	24	"
2.00 S.-" 21.....	92	21	5	" 4, '15	19	"

RESULTS OF MAGNETIC OBSERVATIONS 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
35.00 S.-N.E. cor. sec. 33	92	21	5	Aug. 5, '15	32 18	J. A. Buchanan.
30.00 W.- " 21	92	21	5	" 9, '15	25	"
5.00 W.- " 25	92	21	5	" 10, '15	20	"
18.00 N.-SE. " 1	92	21	5	" 12, '15	25	"
1.00 W.- " 3	24	22	5	" 18, '15	26 03	N. C. Stewart.
At " 2	24	22	5	" 20, '15	05	"
43.00 S.- " 33	27	22	5	Sept. 2, '15	17	"
55.00 W.- " 27	27	22	5	" 3, '15	18	"
Sta. 115 of trav. in sec. 34	28	22	5	" 1, '15	40	"
49.00 S.-NE. cor. sec. 8	28	22	5	" 15, '15	29	"
26.00 E.- " 5	28	22	5	" 16, '15	19	"
22.00 W.- " 2	28	22	5	" 20, '15	16	"
18.00 W.- " 17	28	22	5	Oct. 2, '15	15	"
74.00 W.- " 17	28	22	5	" 4, '15	18	"
41.00 N.- " 18	28	22	5	" 5, '15	16	"
At " 17	28	22	5	" 6, '15	11	"
Sta. 20 of trav. in sec. 31	28	22	5	" 9, '15	16	"
25.50 S.-NE. cor. sec. 3	29	22	5	Sept. 21, '15	18	"
48.00 N.- " 3	29	22	5	" 22, '15	21	"
33.00 W.- " 2	29	22	5	" 23, '15	20	"
At ¼ sec. cor. N. by sec. 13	29	22	5	" 27, '15	21	"
15.00 E.-NE. cor. sec. 11	29	22	5	" 28, '15	23	"
At " 2	29	22	5	" 29, '15	12	"
20.00 S.- " 12	82	22	5	July 17, '14	30 25	A. L. Cumming.
50.00 N.- " 13	82	22	5	" 20, '14	19	"
At SE. " 6	82	22	5	Aug. 17, '14	23	"
At NE. " 4	82	22	5	" 23, '14	37	"
At " 21	82	22	5	" 24, '14	32	"
At " 10	82	22	5	" 26, '14	34	"
7.00 S.- " 11	82	22	5	" 29, '14	36	"
15.00 S.- " 26	82	22	5	Sept. 5, '14	44	"
10.00 E.- " 34	82	22	5	" 12, '14	35	"
38.00 E.- " 34	77	24	5	Jan. 9, '15	06	L. E. Fontaine.
25.00 S.- " 2	85	24	5	May 16, '15	31 40	R. V. Heathcott.
8.00 S.- " 18	85	24	5	" 23, '15	28	"
At " 5	85	24	5	" 20, '15	32 01	"
18.53 S.- " 31	77	25	5	Dec. 23, '14	29 11	L. E. Fontaine.
0.20 S.- " 19	78	25	5	" 27, '14	48	"
14.43 N.- " 10	79	25	5	Jan. 3, '15	30 27	"
30.00 E.- " 7	85	25	5	July 17, '15	31 39	G. J. Lonergan.
At " 16	85	25	5	June 7, '15	35	R. V. Heathcott.
23.00 N.- " 8	85	25	5	" 8, '15	44	"
35.00 W.- " 17	85	25	5	" 15, '15	40	"
13.00 N.- " 11	85	26	5	July 7, '15	25	G. J. Lonergan.
At " 9	49	27	5	Oct. 13, '15	27 30	M. P. Bridgland.
At " 9	49	27	5	" 13, '15	33	"
40.00 S.- " 1	49	28	5	" 13, '15	38	"
At " 2	24	1	6	" 5, '15	25 57	W. J. Johnston.
41.00 S.- " 8	45	1	6	" 3, '15	27 11	M. P. Bridgland.
41.00 S.- " 8	45	1	6	" 3, '15	10	"
40.00 W.- " 10	45	1	6	" 5, '15	13	"
40.00 W.- " 10	45	1	6	" 5, '15	13	"
37.00 W.- " 8	45	1	6	" 5, '15	19	"
37.00 W.- " 8	45	1	6	" 5, '15	19	"
3.00 E.- " 8	45	1	6	" 5, '15	16	"
3.00 E.- " 8	45	1	6	" 5, '15	15	"
20.00 S.- " 8	83	1	6	Aug. 9, '15	31 32	R. V. Heathcott.
25.00 S.- " 27	83	1	6	" 19, '15	35	"
8.00 E.- " 17	83	1	6	" 26, '15	26	"
8.00 N.- " 20	84	1	6	" 2, '15	25	"
45.00 S.- " 19	84	1	6	" 5, '15	25	"
20.00 S.- " 22	84	1	6	" 5, '15	32	"
At " 11	85	1	6	June 29, '15	32	"
At " 3	85	1	6	" 30, '15	31	"
At " 10	85	1	6	July 9, '15	41	"
12.00 S.-NE. cor. sec. 28	85	1	6	" 1, '15	31 32	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
15.00 N.-N.E. cor. sec. 15.	85	1	6	July 3, '15	31 39	R. V. Heathcott.
5.00 E.-" 28	85	1	6	" 13, '15	25	"
5.00 W.-" 21	85	1	6	" 16, '15	35	"
64.00 N.-SE. " 12	91	1	6	April 3, '15	32 57	J. R. Akins.
7.00 N.-" 13	91	1	6	" 13, '15	33 01	"
22.84 N.-NE. " 4	93	1	6	" 28, '15	45	"
12.00 N.-SE. " 1	94	1	6	" 29, '15	57	"
12.00 N.-" 1	94	1	6	" 29, '15	53	"
20.88 S.-NE. " 24	94	1	6	May 2, '15	57	"
36.93 N.-SE. " 1	95	1	6	" 5, '15	34 04	"
21.23 N.-" 13	95	1	6	" 6, '15	05	"
0.26 N.-" 1	96	1	6	" 8, '15	25	"
51.28 N.-" 12	96	1	6	" 10, '15	22	"
53.30 N.-" 13	96	1	6	" 12, '15	26	"
79.30 N.-" 13	96	1	6	" 13, '15	33	"
28.00 N.-" 25	96	1	6	" 13, '15	48	"
21.48 N.-" 1	97	1	6	" 16, '15	35 06	"
21.48 N.-" 1	97	1	6	" 16, '15	34 57	"
7.56 S.-" 36	97	1	6	" 18, '15	38	"
At " 1	98	1	6	" 19, '15	41	"
At " 13	98	1	6	" 20, '15	51	"
7.30 S.-" 36	98	1	6	" 23, '15	35 22	"
7.30 S.-" 36	98	1	6	" 23, '15	20	"
7.30 S.-" 36	98	1	6	" 23, '15	14	"
1.00 S.-" 36	99	1	6	" 27, '15	38	"
38.38 S.-" 25	100	1	6	" 31, '15	47	"
At " 36	100	1	6	June 1, '15	36 02	"
At " 13	101	1	6	" 2, '15	35 54	"
18.69 N.-" 1	102	1	6	" 4, '15	43	"
At NE. " 1	102	1	6	" 6, '15	52	"
9.00 S.-" 1	102	1	6	" 6, '15	48	"
4.00 S.-" 25	102	1	6	" 10, '15	41	"
At " 24	103	1	6	" 16, '15	36	"
40.00 N.-SE. " 25	103	1	6	" 16, '15	29	"
3.00 N.-" 12	104	1	6	" 19, '15	21	"
40.00 S.-NE. " 36	104	1	6	" 21, '15	34 39	"
0.40 S.-SE. " 1	106	1	6	July 9, '15	20	"
0.40 S.-" 1	106	1	6	" 9, '15	20	"
28.00 N.-" 1	107	1	6	" 15, '15	33 18	"
4.00 S.-NE. " 24	107	1	6	" 18, '15	32 48	"
4.00 S.-" 24	107	1	6	" 18, '15	42	"
39.40 N.-SE. " 13	108	1	6	" 22, '15	34 08	"
12.00 S.-NE. " 36	108	1	6	" 25, '15	32 05	"
0.80 N.-SE. " 25	109	1	6	" 28, '15	07	"
At " 1	110	1	6	" 30, '15	27	"
34.74 N.-" 1	111	1	6	Aug. 4, '15	33 19	"
52.71 N.-" 36	111	1	6	" 7, '15	34 00	"
4.00 N.-" 25	113	1	6	" 16, '15	35	"
60.61 W.-NE. " 36	116	1	6	Oct. 18, '15	35 34	"
16.00 W.-" 34	116	1	6	" 19, '15	54	"
16.00 W.-" 34	116	1	6	" 19, '15	36 12	"
16.00 W.-" 34	116	1	6	" 19, '15	00	"
16.00 W.-" 34	116	1	6	" 19, '15	35 28	"
16.00 W.-" 34	116	1	6	" 19, '15	26	"
16.00 W.-" 34	116	1	6	" 19, '15	25	"
16.00 W.-" 34	116	1	6	" 19, '15	27	"
40.00 N.-SE. " 36	116	1	6	Sept. 1, '15	27	"
42.77 N.-" 1	117	1	6	" 2, '15	23	"
0.60 N.-NE. " 24	118	1	6	" 8, '15	29	"
23.60 N.-SE. " 36	119	1	6	" 14, '15	21	"
15.00 N.-" 36	120	1	6	" 17, '15	36	"
73.58 N.-" 25	122	1	6	" 25, '15	36 25	"
11.10 S.-NE. " 25	123	1	6	" 29, '15	12	"
11.10 S.-" 25	123	1	6	" 30, '15	00	"
37.00 W.-" 33	82	2	6	" 27, '15	31 06	R. V. Heathcott.
20.00 N.-" 14	83	2	6	" 7, '15	18	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Townshio.	Range.	Meridian.	Date.	Declination.	Observer.
20.00 N.-N.E. cor. sec. 2	83	2	6	Sept. 24, '15	30 56	R. V. Heathcott.
30.00 N.-	83	2	6	" 8, '15	31 15	"
At	45	3	6	Oct. 10, '15	27 22	M. P. Bridgland.
At	45	3	6	" 10, '15	21	"
20.00 S.-	77	4	6	Aug. 21, '15	29 15	G. J. Lonergan.
At	80	5	6	Oct. 15, '15	30 04	"
39.00 N.-SE.	82	5	6	June 22, '15	29 21	T. A. Davies.
39.00 E.-NE.	83	5	6	Aug. 28, '15	39	G. J. Lonergan.
10.00 E.-	83	5	6	" 10, '15	26	T. A. Davies.
At	84	5	6	Sept. 3, '15	06	G. J. Lonergan.
At	84	5	6	July 5, '15	25	T. A. Davies.
At	72	6	6	Oct. 31, '14	28 31	L. E. Fontaine.
At	72	6	6	Nov. 2, '14	48	"
20.00 E.-	76	6	6	June 10, '15	30 31	G. A. Tipper.
40.00 E.-	76	6	6	" 11, '15	06	"
45.00 N.-	76	6	6	" 15, '15	26	"
25.00 N.-	76	6	6	" 17, '15	11	"
At	76	6	6	" 18, '15	22	"
50.00 E.-	76	6	6	" 21, '15	14	"
60.00 N.-	76	6	6	" 22, '15	22	"
At	76	6	6	" 23, '15	06	"
25.00 S.-	76	6	6	" 26, '15	29 55	"
60.00 E.-	76	6	6	" 26, '15	30 27	"
60.00 S.-	76	6	6	" 30, '15	02	"
14.00 E.-	77	6	6	" 3, '15	22	"
70.00 N.-	77	6	6	" 4, '15	40	"
60.00 N.-	77	6	6	" 5, '15	47	"
40.00 N.-	77	6	6	" 5, '15	49	"
28.28 S.-	78	6	6	Oct. 27, '14	31 02	L. E. Fontaine.
24.00 S.-	81	6	6	Sept. 20, '15	03	H. S. Day.
60.00 W.-	81	6	6	" 21, '15	08	"
45.00 S.-	81	6	6	" 23, '15	30 32	"
35.00 W.-	81	6	6	" 24, '15	31 04	"
10.00 W.-	81	6	6	" 25, '15	37	"
40.00 W.-	81	6	6	" 30, '15	15	"
24.00 W.-	81	6	6	Oct. 1, '15	42	"
25.00 N.-	82	6	6	Aug. 4, '15	29 45	"
20.00 W.-	82	6	6	" 7, '15	50	"
20.00 E.-	82	6	6	" 19, '15	30 04	"
At	83	6	6	Sept. 1, '15	00	G. J. Lonergan.
At	83	6	6	June 24, '15	01	H. S. Day.
20.00 N.-	83	6	6	July 1, '15	29 41	"
10.00 N.-	83	6	6	" 8, '15	30 02	"
20.00 N.-	83	6	6	" 24, '15	29 53	"
10.00 N.-SE.	83	6	6	" 29, '15	36	"
At NE.	84	6	6	Aug. 31, '15	52	G. J. Lonergan.
28.00 S.-	84	6	6	May 21, '15	37	H. S. Day.
At	84	6	6	" 31, '15	29	"
At	84	6	6	June 8, '15	20	"
20.00 N.-	84	6	6	" 11, '15	33	"
30.00 W.-	76	7	6	July 5, '15	30 21	G. A. Tipper.
40.00 E.-	76	7	6	" 6, '15	31	"
At	76	7	6	" 23, '15	25	"
3.00 W.-	77	7	6	Aug. 16, '15	28	G. J. Lonergan.
20.00 W.-	77	7	6	July 30, '15	05	G. A. Tipper.
At	77	7	6	Aug. 14, '15	28	"
30.00 N.-	77	7	6	" 16, '15	24	"
70.00 N.-	77	7	6	" 24, '15	29 56	"
65.00 N.-	78	7	6	Sept. 6, '15	31 06	"
40.00 W.-	78	7	6	" 6, '15	17	"
20.00 W.-	78	7	6	" 13, '15	26	"
55.00 W.-	78	7	6	" 13, '15	10	"
65.00 N.-	78	7	6	" 15, '15	30 42	"
At	78	7	6	Aug. 27, '15	01	"
19.06 E.-	18	8	6	April 26, '15	27 09	W. J. Johnston.
45.00 N.-SE.	18	8	6	May 10, '15	26 31	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—*Continued.*Table 1.—*Declination Observations.*—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
60.00 N.- " 34.....	18	8	6	May 7, '15	25 40	W. J. Johnston.
18.00 N.- " 3.....	20	9	6	" 25, '15	26 14	"
29.00 N.-NE. " 10.....	21	10	6	June 12, '15	25 37	"
20.00 E.- " 10.....	21	10	6	" 14, '15	33	"
At NE. cor. L.S. 5 sec. 22.....	21	10	6	" 17, '15	33	"
31.30 E.-NE. cor. sec. 21.....	21	10	6	" 18, '15	22	"
40.00 N.- " 10.....	22	10	6	" 25, '15	42	"
60.00 N.- $\frac{1}{4}$ I.P.M. N. by sec. 3.....	22	10	6	" 28, '15	22	"
3.00 E.- $\frac{1}{4}$ sec. P. E. by sec. 19.....	22	10	6	July 3, '15	33	"
6.00 E.,						"
40.00 N.-NE. cor. sec. 18.....	22	10	6	" 2, '15	33	"
40.00 S.- " 18.....	23	10	6	Aug. 5, '15	32	"
13.14 N.- " 22.....	74	10	6	Dec. 2, '14	30 38	"
10.00 N.- " 9.....	75	10	6	" 4, '14	55	L. E. Fontaine.
26.74 N.- $\frac{1}{4}$ sec. cor. on E. by sec. 30	17	11	6	May 24, '15	26 02	"
20.77 E.-NE. cor. sec. 30.....	17	11	6	" 26, '15	25 28	C. H. Taggart.
53.01 E.- " 30.....	17	11	6	" 27, '15	16	"
70.70 E.- " 30.....	17	11	6	" 28, '15	33	"
6.19 S.-NE. cor. sec. 29.....	17	11	6	" 28, '15	26 23	"
23.88 S.- " 29.....	17	11	6	" 28, '15	25 16	"
48.63 S.- " 29.....	17	11	6	" 31, '15	58	"
60.77 S.- " 29.....	17	11	6	" 31, '15	26 07	"
50.60 E.- " 29.....	17	11	6	June 1, '15	25 55	"
61.75 E.- " 29.....	17	11	6	" 1, '15	51	"
20.29 W.- " 27.....	17	11	6	" 7, '15	26 00	"
31.93 W.- " 27.....	17	11	6	" 7, '15	25 39	"
43.02 W.- " 27.....	17	11	6	" 8, '15	41	"
55.57 W.- " 27.....	17	11	6	" 8, '15	26 03	"
At " 26.....	17	11	6	" 8, '15	25 50	"
At $\frac{1}{4}$ P. E. by sec. 28.....	17	11	6	" 8, '15	40	"
23.82 S.-NE. cor. sec. 24.....	17	11	6	" 9, '15	26 13	"
7.16 W.-SE. " 12.....	17	11	6	" 22, '15	25 39	"
20.28 W.- " 12.....	17	11	6	" 22, '15	50	"
30.00 W.- " 12.....	17	11	6	" 24, '15	58	"
47.11 W.- " 12.....	17	11	6	" 24, '15	52	"
59.45 W.- " 12.....	17	11	6	" 25, '15	26 09	"
4.43 W.- " 11.....	17	11	6	" 25, '15	25 55	"
20.27 W.- " 11.....	17	11	6	" 25, '15	58	"
34.43 W.- " 11.....	17	11	6	" 25, '15	55	"
55.04 W.- " 11.....	17	11	6	" 26, '15	46	"
62.84 W.- " 11.....	17	11	6	" 27, '15	53	"
56.08 W.- " 10.....	17	11	6	" 29, '15	53	"
19.02 N.-SW. " 10.....	17	11	6	" 30, '15	48	"
26.35 N.- " 10.....	17	11	6	" 30, '15	26 03	"
46.85 N.- " 10.....	17	11	6	July 1, '15	25 47	"
59.45 S.-NE. " 16.....	17	11	6	" 3, '15	59	"
53.19 N.-SW. " 10.....	17	11	6	" 3, '15	52	"
34.95 W.-SE. " 16.....	17	11	6	" 6, '15	26 03	"
53.98 W.- " 16.....	17	11	6	" 6, '15	25 39	"
71.23 W.- " 16.....	17	11	6	" 6, '15	26 35	"
43.89 W.- " 17.....	17	11	6	" 8, '15	11	"
49.17 W.- " 17.....	17	11	6	" 8, '15	22	"
69.25 W.- " 17.....	17	11	6	" 9, '15	09	"
3.80 W.-NE. " 31.....	17	11	6	Aug. 11, '15	25 40	"
13.72 W.- " 31.....	17	11	6	" 12, '15	49	"
0.30 E.-NW. " 31.....	17	11	6	" 12, '15	26 01	"
14.88 E.-NE. " 31.....	17	11	6	" 16, '15	25 54	"
30.99 E.- " 31.....	17	11	6	" 16, '15	55	"
37.58 N.-SE. " 6.....	18	11	6	" 11, '15	25 45	"
9.00 N.-NE. " 6.....	18	11	6	" 13, '15	43	"
6.76 N.- " 5.....	18	11	6	" 18, '15	26 27	"
6.72 W.-SE. $\frac{1}{4}$ sec. 8.....	18	11	6	" 19, '15	25 50	"
At SE. cor. sec. 3.....	23	11	6	July 7, '15	25 34	W. J. Johnston.
At NE. " 3.....	23	11	6	" 8, '15	28	"
At " 6.....	23	11	6	Aug. 20, '15	26 13	"
38.64 S.-NE. " 24.....	17	12	6	June 9, '15	25 56	C. H. Taggart.

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
					⁵ ³	
49.67 S.-N.E. cor. sec. 24.....	17	12	6	June 9, '15	26 03	C. H. Taggart.
49.67 S.- " 24.....	17	12	6	" 10, '15	07	"
62.83 S.- " 24.....	17	12	6	" 10, '15	10	"
22.88 W.-SE. " 24.....	17	12	6	" 11, '15	25 54	"
38.43 W.- " 24.....	17	12	6	" 11, '15	56	"
51.43 W.- " 24.....	17	12	6	" 12, '15	58	"
65.14 W.- " 25.....	17	12	6	" 12, '15	26 04	"
16.73 W.- " 23.....	17	12	6	" 14, '15	03	"
27.97 W.- " 23.....	17	12	6	" 14, '15	13	"
39.54 W.- " 23.....	17	12	6	" 14, '15	18	"
24.70 N.- " 23.....	17	12	6	" 15, '15	07	"
34.41 N.- " 23.....	17	12	6	" 15, '15	02	"
49.62 N.- " 23.....	17	12	6	" 15, '15	25 59	"
60.00 N.- " 23.....	17	12	6	" 16, '15	26 11	"
22.86 N.- " 26.....	17	12	6	" 17, '15	26 08	"
39.29 N.- " 26.....	17	12	6	" 17, '15	26 07	"
11.95 N.-NE. " 26.....	17	12	6	" 18, '15	25 58	"
19.06 N.- " 26.....	17	12	6	" 18, '15	26 06	"
26.46 N.- " 26.....	17	12	6	" 18, '15	06	"
12.48 W.-SE. " 8.....	17	12	6	July 26, '15	24 16	"
1.84 W.- " 8.....	17	12	6	" 27, '15	25 48	"
12.80 S.-NE. " 6.....	17	12	6	" 27, '15	23 05	"
15.58 W.-SE. " 6.....	17	12	6	" 28, '15	25 00	"
67.02 W.- " 6.....	17	12	6	" 29, '15	25 25	"
57.79 N.-SW. " 6.....	17	12	6	" 30, '15	31	"
58.43 N.-NW. " 18.....	17	12	6	Aug. 4, '15	24 27	"
11.20 E.- " 19.....	17	12	6	" 5, '15	27 00	"
25.02 E.- " 19.....	17	12	6	" 5, '15	25 21	"
77.18 E.- " 19.....	17	12	6	" 6, '15	24 13	"
NE. " 29.....	17	12	6	" 7, '15	26 13	"
2.08 S.- " 30.....	17	12	6	" 8, '15	25 24	"
At " 19.....	22	12	6	" 31, '15	26 49	W. J. Johnston.
At " 20.....	22	12	6	Sept. 1, '15	03	"
53.96 N.- " 18.....	70	12	6	Nov. 22, '14	30 30	L. E. Fontaine.
7.44 N.-SE. " 6.....	71	12	6	" 19, '14	30 39	"
71.09 S.-NE. " 29.....	18	13	6	Sept. 10, '15	24 21	C. H. Taggart.
69.63 N.- " 5.....	18	13	6	" 17, '15	09	"
7.20 E.- " 4.....	18	13	6	" 17, '15	21 13	"
24.37 E.- " 4.....	18	13	6	" 17, '15	20 59	"
63.72 E.- " 4.....	18	13	6	" 18, '15	21 02	"
78.58 E.- " 4.....	18	13	6	" 18, '15	25 39	"
73.22 E.- " 4.....	18	13	6	" 18, '15	27 58	"
59.44 S.- " 22.....	18	13	6	Aug. 23, '15	26 46	"
11.18 S.- " 15.....	18	13	6	" 23, '15	24 27	"
41.83 W.- " 15.....	18	13	6	" 24, '15	26 42	"
" 23.....	18	13	6	" 25, '15	25 30	"
3.23 S.- " 23.....	18	13	6	" 26, '15	25 11	"
62.69 S.- " 23.....	18	13	6	" 26, '15	24 41	"
73.56 S.- " 23.....	18	13	6	" 26, '15	46	"
7.31 S.- " 14.....	18	13	6	" 26, '15	25 29	"
4.53 W.- " 11.....	18	13	6	" 27, '15	20	"
34.30 E.-NW. " 14.....	18	13	6	" 30, '15	23 55	"
49.66 E.- " 14.....	18	13	6	" 31, '15	20 31	"
19.28 E.-NE. " 14.....	18	13	6	" 31, '15	24 51	"
36.61 E.- " 14.....	18	13	6	Sept. 1, '15	25 05	"
37.92 N.- " 24.....	18	13	6	" 3, '15	57	"
56.43 E.- " 23.....	18	13	6	" 4, '15	40	"
13.46 N.- " 28.....	18	13	6	" 6, '15	05	"
67.00 E.- " 33.....	18	13	6	" 7, '15	21	"
At " 24.....	22	13	6	Aug. 29, '15	27 21	W. J. Johnston.
20.00 N.-NE. " 13.....	22	13	6	" 30, '15	26 38	"
At " 24.....	22	13	6	" 28, '15	27 00	"
At " 1.....	22	13	6	Sept. 7, '15	34	"
21.63 S.- " 36.....	69	13	6	Nov. 25, '14	30 38	L. E. Fontaine.
5.19 N.- $\frac{1}{4}$ sec. cor. on E. by sec. 6...	18	15	6	May 15, '15	26 19	C. H. Taggart.
35.63 S.-NE. cor. sec. 5.....	18	15	6	" 16, '15	25 56	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—*Continued.*

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
At $\frac{1}{4}$ sec. cor. on N. by sec. 17.....	18	15	6	May 16, '15	26 33	C. H. Taggart.
62.01 E.-NE. cor. sec. 15.....	20	15	6	Oct. 12, '15	25 56	"
5.15 S.-" 15.....	20	15	6	" 13, '15	24 23	"
58.75 N.-" 7.....	77	16	6	June 13, '15	30 20	S. D. Fawcett.
30.00 N.-" 17.....	80	16	6	Sept. 18, '15	30 28	G. J. Lonergan.
15.00 E.-" 17.....	80	16	6	" 19, '15	40	"
35.50 S.-" 21.....	80	16	6	" 15, '15	30 29	S. D. Fawcett.
19.45 N.-" 9.....	77	17	6	June 30, '15	30 22	"
32.00 N.-" 33.....	77	17	6	July 24, '15	13	"
At " 34.....	77	17	6	Oct. 4, '15	30 22	G. J. Lonergan.
60.00 E.-" 10.....	78	17	6	" 3, '15	30 32	"
20.00 W.-" 16.....	78	17	6	Aug. 8, '15	30 22	S. D. Fawcett.
20.00 E.-" 33.....	79	17	6	Oct. 1, '15	30 03	"
28.00 W.-" 22.....	80	17	6	Sept. 23, '15	30 17	"
66.00 W.-" 9.....	80	17	6	" 24, '15	10	"
10.00 W.-" 26.....	80	17	6	" 25, '15	18	"
0.75 W.- $\frac{1}{4}$ sec. N. by sec. 28.....	82	17	6	Oct. 2, '15	31 07	L. Brenot.
At NE. cor. sec. 29.....	82	17	6	Sept. 30, '15	10	"
At " 27.....	82	17	6	Oct. 1, '15	18	"
7.00 S.-" 10.....	83	17	6	Aug. 30, '15	31 28	"
10.00 N.-" 5.....	83	17	6	" 27, '15	40	"
20.00 N.-SE. " 31.....	83	17	6	Sept. 7, '15	09	"
10.00 E.-" 4.....	83	17	6	" 30, '15	09	"
30.00 N.-NE. " 15.....	83	17	6	" 24, '15	31 01	G. J. Lonergan.
At " 21.....	83	17	6	" 25, '15	31 11	"
At " 22.....	84	17	6	" 26, '15	31 33	"
At " 23.....	84	17	6	" 15, '15	31 32	L. Brenot.
1.50 N.-" 22.....	84	17	6	" 19, '15	16	"
66.20 W.-" 32.....	19	19	6	Oct. 1, '15	26 41	C. H. Taggart.
14.70 E.-" 30.....	19	19	6	" 4, '15	01	"
50.60 E.-" 30.....	19	19	6	" 4, '15	25 51	"
6.60 E.-" 29.....	19	19	6	" 4, '15	52	"
14.04 E.-" SE. $\frac{1}{4}$ sec. 28...	19	19	6	" 6, '15	26 07	"
22.68 S.-" 27.....	19	19	6	" 6, '15	09	"
66.00 N.-" 8.....	20	19	6	Sept. 27, '15	26 07	"
57.90 E.- $\frac{1}{4}$ E. by. sec. 33.....	22	21	6	" 29, '15	26 34	J. A. Calder.
14.60 E.-NE. cor. sec. 2.....	22	21	6	" 27, '15	27 54	"
30.00 E.- $\frac{1}{4}$ on E. by. sec. 26.....	22	21	6	Oct. 4, '15	28 33	"
10.00 S.-NE. cor. sec. 8.....	84	22	6	Aug. 17, '15	31 32	L. Brenot.
At " 6.....	84	22	6	" 22, '15	37	"
25.00 S.-" 10.....	84	22	6	" 17, '15	10	"
73.00 N.-SE. cor. sec. 4.....	8	23	6	April 28, '15	26 18	P. J. McGarry.
At N.E. " 11.....	8	23	6	May 3, '15	26	"
At " 24.....	8	23	6	" 15, '15	01	"
63.00 N.-" 23.....	8	23	6	" 18, '15	25 56	"
75.00 N.-" 10.....	8	23	6	" 24, '15	55	"
78.00 E.-" 14.....	8	23	6	" 25, '15	51	"
$\frac{1}{4}$ sec. cor. on N. by. sec. 23.....	8	23	6	" 26, '15	26 20	"
68.00 N.-NE. cor. sec. 3.....	8	23	6	" 28, '15	01	"
55.00 W.-" 10.....	8	23	6	" 29, '15	12	"
36.00 E.-of $\frac{1}{4}$ sec. cor. on E. by. sec. 16.	8	23	6	June 1, '15	10	"
70.00 E.-NE. cor. sec. 35.....	8	23	6	" 7, '15	25 58	"
45.00 E.-" 24.....	8	23	6	" 11, '15	25 35	"
59.00 N.-" 10.....	9	23	6	" 22, '15	25 34	"
29.00 E.-" 11.....	9	23	6	" 25, '15	51	"
73.00 N.-" 14.....	9	23	6	July 1, '15	26 00	"
79.00 S.-" 22.....	9	23	6	" 5, '15	07	"
39.00 E.-" 26.....	9	23	6	" 9, '15	25 59	"
At " 36.....	9	23	6	" 21, '15	26 08	"
At " 2.....	9	23	6	June 8, '15	08	"
32.70 W.-" 29.....	15	23	6	" 15, '15	25 17	J. A. Calder.
39.90 W.-" 19.....	15	23	6	" 19, '15	27	"
12.00 N.-						
At centre sec. 16.....	15	23	6	" 21, '15	26 03	"
35.00 N.-NE. cor. sec. 30.....	15	23	6	" 23, '15	24 57	"
30.00 W.-						

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Continued.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
35.00 E.-N.E. cor. sec.31.....	15	23	6	June 24, '15	25 46	J. A. Calder.
35.00 S.-NE.						
0.90 W.- " 29.....	15	23	6	" 25, '15	18	"
4.20 E.-centre sec. 26.....	15	23	6	July 1, '15	43	"
47.00 S.-NE. cor. sec. 28.....	83	23	6	Aug. 1, '15	31 47	L. Brenot.
40.00 S.- " 29.....	83	23	6	July 29, '15	33	"
40.00 E.- " 20.....	83	23	6	Aug. 2, '15	36	"
At " 7.....	83	23	6	" 6, '15	37	"
40.00 E.- " 23.....	83	23	6	" 9, '15	31 37	"
2.00 W.- " 18.....	83	23	6	July 13, '15	21	"
At " 34.....	83	23	6	" 24, '15	36	"
48.00 N.- " 30.....	83	23	6	" 30, '15	22	"
3.00 S.- " 22.....	83	23	6	Aug. 7, '15	43	"
37.00 N.- " 10.....	83	23	6	" 9, '15	47	"
20.00 E.- " 9.....	83	23	6	" 11, '15	40	"
46.00 N.- " 5.....	83	23	6	" 12, '15	36	"
11.75 W.- " 32.....	15	24	6	May 1, '15	24 51	J. A. Calder.
30.00 S.- " 31.....	15	24	6	" 4, '15	25 05	"
41.00 W.-NE.						
0.17 S.- " 32.....	15	24	6	" 12, '15	27 00	"
3.70 E.- " 29.....	15	24	6	" 21, '15	25 13	"
11.00 S.- " 22.....	15	24	6	" 22, '15	27 59	"
3.00 E.-NE.						
65.00 S.- " 30.....	15	24	6	" 25, '15	21 22	"
1.00 E.- " 26.....	15	24	6	June 11, '15	25 21	"
13.00 N.-NE.						
47.20 S.- " 35.....	15	24	6	" 18, '15	26 31	"
5.07 S.- $\frac{1}{4}$ E. by. sec. 19.....	16	24	6	April 20, '15	28 02	"
31.27 S.-NE. cor. sec. 7.....	16	24	6	" 23, '15	27 05	"
36.05 S.- " 17.....	16	24	6	" 26, '15	25 37	"
40.26 W.- " 6.....	16	24	6	May 10, '15	19 27	"
45.34 S.- " 6.....	16	24	6	" 11, '15	22 31	"
16.86 S.-NW. cor. Nicomen, I.R.No. 12.....	16	24	6	" 14, '15	29 08	"
6.40 N.-centre sec. 10.....	16	24	6	" 31, '15	27 01	"
6.40 N.- " 10.....	16	24	6	June 1, '15	02	"
2.50 S.- " 27.....	16	24	6	" 2, '15	28 12	"
10.00 S.-NE. cor. sec. 8.....	83	24	6	" 21, '15	30 48	L. Brenot.
At " 16.....	83	24	6	July 1, '15	31 09	"
20.00 S.- " 10.....	83	24	6	" 4, '15	12	"
7.00 W.- " 12.....	83	24	6	" 7, '15	27	"
10.00 S.- " 11.....	83	24	6	" 8, '15	24	"
5.00 W.- " 13.....	83	24	6	" 8, '15	25	"
8.00 N.- " 12.....	83	24	6	" 10, '15	23	"
9.50 N.- " 30.....	22	25	6	Aug. 19, '15	26 24	J. A. Calder.
43.40 W.- " 31.....	22	25	6	" 20, '15	27 11	"
40.60 W.- " 30.....	22	25	6	" 25, '15	26 09	"
6.00 W.-SE. " 19.....	22	25	6	" 27, '15	19	"
40.00 N.-SE.						
At NE. " 10.....	22	25	6	" 30, '15	43	"
47.80 N.- " 10.....	22	25	6	" 31, '15	43	"
17.00 S.- $\frac{1}{4}$ N. by. sec. 34.....	22	25	6	Sept. 3, '15	28 51	"
42.50 S.-NE. cor. sec. 8.....	22	25	6	" 8, '15	26 46	"
45.00 N.- " 28.....	82	25	6	June 13, '15	30 36	L. Brenot.
5.20 S.-NW. " 19.....	19	26	6	July 12, '15	25 28	J. A. Calder.
18.30 N.- " 19.....	19	26	6	" 15, '15	26 08	"
51.20 E.-SW. " 6.....	19	26	6	" 17, '15	28 19	"
7.00 E.- " 5.....	19	26	6	" 20, '15	26 05	"
44.10 E.- " 4.....	19	26	6	" 22, '15	21 09	"
46.40 S.-NE. " 8.....	19	26	6	" 23, '15	26 15	"
50.30 S.- " 5.....	19	26	6	" 24, '15	54	"
21.00 N.-SE. " 4.....	19	26	6	" 26, '15	27 20	"
16.90 N.-NE. " 4.....	19	26	6	" 29, '15	01	"
33.90 S.- " 16.....	19	26	6	" 30, '15	26 20	"
36.30 S.- " 28.....	19	26	6	Aug. 2, '15	23	"
50.40 S.- " 20.....	19	26	6	" 7, '15	06	"

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RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—*Continued.*Table 1.—*Declination Observations.*—Continued.

Place.	Township.	Range.	Ereidian.	Date.	Declination.	Observer.
					⁵ ³	
43.70 S.-N.E. cor. sec. 17.....	19	26	6	Aug. 9, '15	25 50	J. A. Calder.
At $\frac{1}{4}$ W. by. sec. 31.....	20	26	6	Oct. 8, '15	26 07	"
At Sta. 14 Trav. Hat creek sec. 31..	20	26	6	" 11, '15	07	"
39.60 S.-NE. cor. sec. 36.	22	26	6	Aug. 21, '15	27 07	"
18.40 S.-" 24.....	22	26	6	" 23, '15	26 31	"
5.00 S.-" 12.....	83	26	6	June 8, '15	30 24	L. Brenot.
7.00 S.-" 12.....	84	26	6	" 4, '15	30 34	"
75.00 E.-NW. " 31.....	1	27	6	Sept. 22, '15	25 50	P. J. McGarry.
58.00 E.-NE. " 31.....	1	27	6	" 25, '15	26 06	"
74.00 E.- $\frac{1}{4}$ sec. cor. on E. by., sec. 6.	2	27	6	" 29, '15	25 49	"
22.00 N.-NE. cor. sec. 30.....	1	28	6	Aug. 20, '15	24 46	"
37.00 E.- $\frac{1}{4}$ sec. cor. on E. by. sec. 31	1	28	6	" 23, '15	25 28	"
37.00 E.- $\frac{1}{4}$ sec. cor. on W. by. sec. 30.	1	28	6	" 28, '15	06	"
At centre. of sec. 33.....	1	28	6	Sept. 4, '15	25 15	"
71.00 N.-SE. cor. sec. 4.	2	28	6	" 7, '15	24 55	"
At NE. " 3.....	2	28	6	" 9, '15	25 21	"
10.30 E.-Wit. I.T.S.M. 30 S. for SW.						
cor. L. 29 G. 1.....	18	28	6	" 19, '15	27 08	J. A. Calder.
53.00 W.-NE. cor. sec. 21.....	1	29	6	" 5, '15	24 20	P. J. McGarry.
38.00 N.-" 22.....	1	29	6	" 7, '15	01	"
At Trav. Sta. 37, sec. 17.....	3	29	6	Sept. 1, '15	24 41	J. Gibbon.
At " 37 " 17.....	3	29	6	" 1, '15	42	"
At " 37 " 17.....	3	29	6	" 1, '15	39	"
2.30 W.-E. $\frac{1}{4}$ sec. cor. sec. 19.....	4	29	6	Aug. 13, '15	24 46	"
2.30 W.-" 19.....	4	29	6	" 13, '15	45	"
2.30 W.-" 19.....	4	29	6	" 13, '15	47	"
2.30 W.-" 19.....	4	29	6	" 14, '15	47	"
2.30 W.-" 19.....	4	29	6	" 14, '15	49	"
2.30 W.-" 19.....	4	29	6	" 14, '15	47	"
74.20 W.-E. by. sec. 8.....	4	29	6	" 21, '15	37	"
74.20 W.-" 8.....	4	29	6	" 21, '15	46	"
74.20 W.-" 8.....	4	29	6	" 21, '15	47	"
Triangulation pt. 8 E. sec. 10.....	3	30	6	Oct. 3, '15	22 40	"
" " 10.....	3	30	6	" 3, '15	41	"
" " 10.....	3	30	6	" 3, '15	43	"
25.40 N.-NE. cor. sec. 5.....	4	2	7	Sept. 21, '15	24 46	W. H. Norrish.
At " 6.....	4	2	7	" 25, '15	24 46	"
25.70 E.-NW. " 7.....	6	2	7	Aug. 14, '15	22 47	"
50.70 N.-NE. " 7.....	6	2	7	" 20, '15	24 05	"
25.20 E.-NW. " 17.....	6	2	7	" 21, '15	27 40	"
9.30 E.-NE. " 17.....	6	2	7	" 24, '15	22 24	"
43.30 E.-" 17.....	6	2	7	" 27, '15	23 21	"
28.00 N.-" 16.....	6	2	7	" 30, '15	28	"
20.20 E.-" 21.....	6	2	7	Sept. 4, '15	22 32	"
17.30 S.-" 7.....	6	3	7	July 9, '15	27 21	"
12.10 E.-" 6.....	6	3	7	" 11, '15	29 15	"
10.10 E.-" 5.....	6	3	7	" 18, '15	25 12	"
41.40 E.-" 5.....	6	3	7	" 19, '15	30 50	"
49.30 E.-" 5.....	6	3	7	" 21, '15	28 22	"
23.40 E.-" 4.....	6	3	7	" 24, '15	29 39	"
37.10 E.-" 4.....	6	3	7	" 26, '15	25 28	"
62.00 E.-" 4.....	6	3	7	" 27, '15	27 19	"
33.10 E.-" 3.....	6	3	7	" 29, '15	24 17	"
51.90 E.-" 3.....	6	3	7	" 30, '15	28 04	"
70.80 E.-" 3.....	6	3	7	" 31, '15	21 19	"
23.40 E.-" 2.....	6	3	7	Aug. 3, '15	25 18	"
72.90 E.-" 2.....	6	3	7	" 6, '15	21 38	"
At " 1.....	6	3	7	" 7, '15	21 14	"
51.30 N.-" 1.....	6	3	7	" 11, '15	21 03	"
10.66 E.-" 17.....	6	4	7	May 23, '15	25 14	"
18.70 W.-" 14.....	6	4	7	June 15, '15	24 59	"
At " 14.....	6	4	7	" 19, '15	25 24	"
41.10 E.-" 11.....	6	4	7	" 28, '15	24 20	"
At $\frac{1}{4}$ sec. cor. N. by. sec. 17.....	7		E C	" 29, '15	24 48	J. Gibbon.
At " 17.....	7		"	" 29, '15	46	"
At " 17.....	7		"	" 29, '15	44	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

Table 1.—Declination Observations.—Concluded.

Place.	Township.	Range.	Meridian.	Date.	Declination.	Observer.
At $\frac{1}{4}$ sec. cor. E. by. sec. 24.....	14	.	"	Aug. 4, '15	22 35	J. Gibbon.
At " " 24	14	.	"	" 4, '15	37	"
At " " 24.....	14	.	"	" 4, '15	38	"
At " " 24.....	14	.	"	" 5, '15	22 32	"
At " " 24.....	14	.	"	" 5, '15	41	"
At " " 24.....	14	.	"	" 5, '15	35	"
30-60 E.-NW. cor. sec. 6.....	21	...	"	Sept. 11, '15	23 55	W. H. Norrish.
23-50 E.-W. $\frac{1}{4}$ " 23	1	...	W C	May 22, '15	24 33	J. Gibbon.
23-50 E.-W. $\frac{1}{4}$ " 23	1	...	"	June 3, '15	31	"
55-30 W.-NE. " 16.....	1	...	"	" 4, '15	42	"
23-60 S.-N. $\frac{1}{4}$ " 23	1	...	"	" 10, '15	37	"
23-60 S.-N. $\frac{1}{4}$ " 23	1	...	"	" 10, '15	40	"
23-60 S.-N. $\frac{1}{4}$ " 23	1	...	"	" 10, '15	34	"
23-60 S.-N. $\frac{1}{4}$ " 23	1	...	"	" 14, '15	42	"
23-60 S.-N. $\frac{1}{4}$ " 23	1	...	"	" 14, '15	42	"
23-60 S.-N. $\frac{1}{4}$ " 23	1	...	"	" 14, '15	37	"
At NE. " 17.....	2	...	"	April 27, '15	24 09	"
15-60 E.-W. $\frac{1}{4}$ " 20	2	...	"	July 13, '15	13	"
15-60 E.-W. $\frac{1}{4}$ " 20	2	...	"	" 13, '15	18	"
15-60 E.-W. $\frac{1}{4}$ " 20	2	...	"	" 13, '15	11	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—Continued.

TABLE II.—Inclination and Total Intensity.

Station. Distance in chains from nearest post.	Town- ship.	Range.	Meri- dian.	Date.	INCLINATION.		TOTAL INTENSITY.		Observer.	Instrument.
					L. M. T.	Value.	L. M. T.	Value.		
0.50 E.- $\frac{1}{4}$ P. N. by. sec. 6.	3	12	E. Pr.	May 25	8.8-10.7	77 37.5	9.3-9.9	c.g.s. 0.63289	E. K. Robinson...	T.S. 61.
0.50 E.- $\frac{1}{4}$ S. NE. cor. sec. 6	3	12	"	" 25	10.0-11.9	77 37.6	10.8-11.3	0.63256	"	"
39.50 S. NE. cor. sec. 10	4	10	"	June 6	9.8-11.3	77 35.5	10.3-10.8	0.62730	"	"
39.50 S.- $\frac{1}{4}$ N. by. sec. 4.	4	10	"	" 6	10.9-12.4	35.1	11.4-11.9	0.62741	"	"
2.61 N.- $\frac{1}{4}$ N. by. sec. 4.	18	20	Pr.	May 13	7.8-10.1	77 59.6	8.7-9.5	0.63049	"	"
2.61 N.- $\frac{1}{4}$ S. NE. cor. sec. 4.	18	20	"	" 13	9.6-11.3	78 00.7	10.2-10.8	0.62993	"	"
20.00 S. NE. cor. sec. 9	3	22	"	Oct. 28	10.3-12.0	77 03.1	10.9-11.4	0.63047	"	"
20.00 S.- $\frac{1}{4}$ N. by. sec. 3	3	22	"	" 28	11.5-15.1	03.0	14.0-14.7	0.62979	"	"
2.50 S.- $\frac{1}{4}$ N. by. sec. 21	15	7	3	Sept. 30	14.6-16.1	76 16.4	15.1-15.6	0.62073	"	"
20.00 S.- $\frac{1}{4}$ N. by. sec. 9	17	7	3	Oct. 3	15.4-17.1	76 31.5	16.1-16.6	0.62364	"	"
20.00 S.- $\frac{1}{4}$ N. by. sec. 9	17	7	3	" 3	16.7-18.0	31.1	17.2-17.6	0.62527	"	"
4.00 S., 9.00 E.- $\frac{1}{4}$ E. by. sec. 13	36	14	3	May 5	10.1-11.2	77 22.0	10.5-10.8	0.62693	R. C. Purser.....	T.S. 62.
4.00 S., 9.00 E.- $\frac{1}{4}$ N. by. sec. 13	36	14	3	" 5	10.8-12.1	77 21.2	11.2-11.6	0.62691	"	"
1.00 S., 1.50 W.-NE. cor. sec. 10	36	16	3	June 1	15.4-16.4	77 26.5	15.9-16.2	0.62523	"	"
1.00 S., 1.50 W.- $\frac{1}{4}$ N. by. sec. 10	36	16	3	" 1	16.2-17.1	27.2	16.4-16.8	0.62514	"	"
1.00 S., 1.50 W.- $\frac{1}{4}$ N. by. sec. 10	36	16	3	" 1	16.8-17.8	27.4	17.1-17.5	0.62513	"	"
10.00 N., 10.00 W.- $\frac{1}{4}$ E. by. sec. 15	36	16	3	May 30	8.6-9.8	77 25.0	9.2-9.5	0.62400	"	"
10.00 N., 10.00 W.- $\frac{1}{4}$ E. by. sec. 15	36	16	3	" 30	9.5-10.6	25.1	9.8-10.2	0.62399	"	"
10.00 N., 10.00 W.- $\frac{1}{4}$ E. by. sec. 15	36	16	3	" 30	10.2-11.3	25.0	10.6-10.9	0.62390	"	"
5.00 S., 22.00 W.- $\frac{1}{4}$ N. by. sec. 16	36	16	3	" 31	8.8-10.0	77 27.6	9.3-9.7	0.62356	"	"
5.00 S., 22.00 W.- $\frac{1}{4}$ N. by. sec. 16	36	16	3	" 31	9.7-10.7	27.7	10.0-10.4	0.62346	"	"
5.00 S., 22.00 W.- $\frac{1}{4}$ N. by. sec. 16	36	16	3	" 31	10.4-11.4	27.4	10.7-11.0	0.62344	"	"
20.00 W.- $\frac{1}{4}$ E. by. sec. 21	38	16	3	" 24	8.5-10.1	77 28.3	9.0-9.6	0.62216	R. C. Purser.....	"
20.00 W.- $\frac{1}{4}$ S. NE. cor. sec. 21	38	16	3	" 24	9.7-10.9	28.4	10.1-10.5	0.62161	"	"
18.00 N.-NE. cor. sec. 23	18	17	3	Sept. 11	14.3-15.9	76 16.1	14.8-15.3	0.61917	E. K. Robinson...	T.S. 61.
18.00 N.- $\frac{1}{4}$ S. NE. cor. sec. 23	18	17	3	" 11	15.5-17.0	15.7	16.0-16.6	0.61711	"	"
1.00 S.- $\frac{1}{4}$ N. by. sec. 36	18	19	3	" 16	9.5-10.9	76 12.5	10.1-10.5	0.62164	"	"
39.00 S.- $\frac{1}{4}$ N. by. sec. 36	13	22	3	Aug. 17	14.2-15.7	75 47.5	14.7-15.2	0.62544	"	"
39.00 S.- $\frac{1}{4}$ N. by. sec. 36	13	22	3	" 17	15.3-16.7	47.1	15.8-16.3	0.62497	"	"
5.00 W.- $\frac{1}{4}$ N. by. sec. 36	12	29	3	" 7	15.0-16.4	75 24.2	15.4-16.0	0.61550	"	"
5.00 W.- $\frac{1}{4}$ S. NE. cor. sec. 36	12	29	3	" 7	16.0-17.5	24.6	16.4-16.9	0.61516	"	"
25.00 N., 30.00 W.-NE. cor. sec. 3	53	1	4	June 26	7.4-8.5	78 02.2	7.8-8.2	0.62167	E. J. Wight.....	T.S. 62.
25.00 N., 30.00 W.- $\frac{1}{4}$ N. by. sec. 3	53	1	4	" 26	8.2-9.3	02.6	8.5-8.9	0.62171	"	"
25.00 N., 30.00 W.- $\frac{1}{4}$ N. by. sec. 3	53	1	4	" 26	8.9-9.9	02.6	9.2-9.6	0.62171	"	"

RESULTS OF MAGNETIC OBSERVATIONS, 1915-16.—*Concluded.*
TABLE II.—*Inclination and Total Intensity—Concluded.*

Station. Distance in chains from nearest post.	Town- ship.	Range.	Meri- dian.	Date.	INCLINATION.		TOTAL INTENSITY.		Observer.	Instrument.
					L. M. T.	Value.	L. M. T.	Value.		
4-30 W., 4-30 N.-N.E. cor. sec. 24.	53	1	4	June 16	8-5 9-9	78 08-2	9-0-9-5	^{c.g.s.} 0-62330	R. C. Purser	T.S. 62
4-30 W., 4-30 N.-" " 24.	53	1	4	" 16	9-5 10-9	06-5	9-9 10-4	0-62177	"	"
4-30 W., 4-30 N.-" " 24.	53	1	4	" 16	10-4 11-6	07-8	10-9 11-3	0-62207	"	"
6-00 S., 25-00 W.-1 E. by. sec. 12.	43	3	4	July 5	8-0-9-4	77 31-8	8-4-8-9	0-62677	"	"
6-00 S., 25-00 W.-" " 12	43	3	4	" 5	8-9-10-2	32-1	9-4 9-8	0-62735	"	"
6-00 S., 25-00 W.-" " 12	43	3	4	" 5	9-8 11-1	32-7	10-2-10-7	0-62697	"	"
13-00 E., 16-00 S.-N.E. cor. sec. 32.	28	5	4	" 21	7-1-8-3	76 17-2	7-5-7-9	0-61676	E. J. Wight.	"
13-00 E., 16-00 S.-" " 32.	28	5	4	" 21	7-9-8-9	76 17-2	8-3-8-6	0-61676	"	"
13-00 E., 16-00 E.-" " 32.	28	5	4	" 21	8-6 9-6	17-2	8-9 9-3	0-61679	"	"
20-00 N., 3-00 E.-" " 8.	41	12	4	" 8	7-9-9-4	76 52-6	8-3-8-9	0-61831	R. C. Purser	"
20-00 N., 3-00 E.-" " 8.	41	12	4	" 8	8-9 10-0	53-3	9-4 9-7	0-61833	"	"
20-00 N., 3-00 E.-" " 8.	41	12	4	" 8	9-7 10-6	52-0	10-1-10-3	0-61819	"	"
1-00 W.-centre sec. 5.	31	14	4	" 23	9-5 10-8	76 23-0	10-0 10-5	0-61706	E. J. Wight	"
1-00 W.-" " 5.	31	14	4	" 23	10-4 11-5	23-2	10-8 11-1	0-61707	"	"
1-00 W.-" " 5.	31	14	4	" 23	11-1 12-2	23-0	11-4 11-9	0-61706	"	"
16-50 N.-S.E. cor. sec. 2.	1	26	4	" 26	9-1 10-4	74 13-6	9-4-9-9	0-61241	E. K. Robinson	T.S. 61.
16-50 N.-" " 2.	1	26	4	" 26	10-0 11-4	15-2	10-3 10-9	0-61210	"	"
12-00 E., 26-00 S.-N.E. cor. sec. 4.	53	27	4	Aug. 4	13-6 14-6	77 08-9	14-0 14-3	0-61783	E. J. Wight	T.S. 62
12-00 E., 26-00 S.-" " 4.	53	27	4	" 4	14-3 15-4	08-7	14-6 15-0	0-61783	"	"
12-00 E., 26-00 S.-" " 4.	53	27	4	" 4	15-0 16-1	08-9	15-4 15-7	0-61786	"	"
4-15 S., 3-00 W.-1 E. by. sec. 11.	53	4	5	July 31	13-0 14-1	77 17-2	13-4 13-9	0-61720	"	"
4-15 S., 3-00 W.-" " 11.	53	4	5	" 31	13-9 14-8	17-3	14-1 14-4	0-61723	"	"
4-15 S., 3-00 W.-" " 11.	53	4	5	" 31	14-4 15-4	17-2	14-7 15-1	0-61723	"	"
0-25 S.-N.E. cor. sec. 26.	25	12	5	June 12	15-1 16-8	74 54-1	15-8 16-2	0-61294	E. K. Robinson	T.S. 61.
0-25 S.-" " 26.	25	12	5	July 19	15-6 16-1	55-8	16-0 16-5	0-61164	"	"

APPENDIX No. 73.
SURVEYS LABORATORY—RESULTS OF WATCH TESTS.
SURVEYS LABORATORY METHOD.

Name.	Number of Watch.	Escapement, Balance Spring, etc	Mean Daily Variation of Mean Daily Rate.										Mean Error.	Diff. between m.d.r. and m. of m.d.r. at 65° F.					Mean Error.	M.ch. of r. for β	Total Marks. 1° F.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
			Mean Daily Variation of Mean Daily Rate.											α	Diff. between m.d.r. and m. of m.d.r. at 65° F.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
			P.U. 65°	P.R. 65°	P.L. 65°	D.U. 40°	D.U. 65°	D.U. 90°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°		D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°		P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°	D.U. 65°	D.D. 65°	P.U. 65°	P.R. 65°	P.L. 65°

BUREAU OF STANDARDS METHOD.

Name.	Number of Watch.	Escapement, Balance Spring, etc.	Mean deviation of daily rate.	Mean of daily rate for each pair of position tests.	Deviation for change of position.	Maximum difference between mean rates of position tests.	Difference between mean rates of P. U. and D. U. positions.	Difference between mean rates of D. U. and D. D. positions.	Progressive change of rate for position tests.	Recovery of rate.	Change of r. per 1° C.		Algebraic difference between A and B.	Isochronism Error.	Marks.
			0 ^s .75		3 ^s .0	10 ^s .0	5 ^s .0	4 ^s .0	3 ^s .0	6 ^s .0	A	B	0 ^s .3	3 ^s .0	
											4:4-18:3	4:4-32:2			
Maximum values allowable.															
Waltham Watch Co.	T.S. 491	D.r., g.b., l.e., s.o.	0.30	+0.47	1.19	3.80	2.56	1.58	-0.72	-2.37	-0.036	+0.049	0.08	+1.7	64.1 p.c.
"	14172573	"	0.33	-5.87	1.44	5.13	3.26	1.87	+0.36	+1.27	-0.236	-0.111	0.12	-0.1	56.3
"	18028587	"	0.43	+0.09	0.76	2.23	2.23	0.53	+0.05	+2.10	+0.055	+0.105	0.16	+2.7	55.9
"	18091025	"	0.35	+3.22	0.59	2.19	1.07	0.09	+0.73	+1.73	+0.013	+0.194	0.18	+0.5	54.7
"	14125109	"	0.30	+2.81	2.09	7.47	0.23	2.22	+0.30	+0.27	+0.122	+0.065	0.19	+1.2	51.6
"	19001011	"	0.42	-1.83	1.59	4.78	1.42	3.36	+0.08	+0.27	-0.314	-0.049	0.26	+0.3	48.0
"	18028543	"	0.31	-0.27	2.94	9.63	1.20	2.22	+0.95	+1.53	-0.206	-0.057	0.15	+1.3	43.3
		Means.....	0.35	2.08	1.51	5.03	1.71	1.70	0.46	1.36	0.14	0.09	0.16	1.1	

SESSIONAL PAPER No. 25b

APPENDIX No. 74.

SURVEYING INSTRUMENTS ON HAND, MARCH 31, 1916.

Instruments.	In Store April 1915.	Purchased	Sold.	BALANCE ON HAND.		Remarks.
				Loan.	Store.	
Abney levels.....	42	27	28	3	38	
Alidades.....	1				1	
Alt-azimuths.....	1				1	
Aneroids.....	94		3	10	81	
Artificial Horizons.....	4				4	
Base line apparatus.....	1				1	
Cameras and Kodaks..	18			1	17	
Chronometers and Sid- ereal Watches.....	62	1	7	7	48	1 returned to factory.
Compasses.....	34				34	
Current Meters and logs	4				4	
Dip circles.....	2				2	
Field glasses and bino- culars.....	7	1		1	5	1 lost. 1 stolen.
Levels.....	38	15		30	23	
Levelling rods.....	65	22		42	38	7 worn out.
Micrometer telescopes..	8				8	
Optical squares.....	1				1	
Pedometers.....	2				2	
Photo-theodolites.....	5			1	4	
Plane tables.....	1				1	
Protractors.....	40	40		44	34	2 broken.
Rod levels.....	22			6	13	3 worn out.
Sextants and reflecting circles.....	3				3	
Solar compasses.....	2				2	
Stadia rods.....	19	76	47	1	47	
Stadia slide rules.....	21	40		27	34	
Steel tapes.....	139	56	55	13	126	1 worn out.
Subsidiary standard measures.....	102		12		90	
Survey pickets.....	2				2	
Surveying cameras.....	4			1	3	
Tally registers.....	12				12	
Tape stretching appa- ratus.....	1				1	
Telemeters.....	1			1		
Thermometers.....	16		2	6	8	
Transit Theodolites....	64	22	21	11	53	1 struck off.
Zenith Telescopes.....	1				1	

DEPARTMENT OF THE INTERIOR, CANADA
IRRIGATION BRANCH

ROLL OF HONOUR

Employees Killed for Active Service

1. H. H. ...	Lepine	Aug. 12, 1914	First Lieut. 1st Reg. Ill. A.
2. J. ...	... ..	Aug. 17, 1914	Lt. Col. 1st Reg. Ill. A.
3. J. ...	... ..	Aug. 17, 1914	Master Sergeant 1st Reg. Ill. A.
4. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
5. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
6. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
7. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
8. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
9. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
10. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
11. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
12. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
13. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
14. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
15. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
16. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
17. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
18. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
19. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
20. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
21. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
22. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
23. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
24. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
25. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
26. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
27. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
28. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
29. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
30. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
31. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
32. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
33. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
34. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
35. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
36. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
37. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
38. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
39. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
40. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
41. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
42. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
43. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
44. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
45. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
46. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
47. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
48. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
49. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.
50. J. ...	... ..	Aug. 17, 1914	Sgt. 1st Reg. Ill. A.

DEPARTMENT OF THE INTERIOR, CANADA
IRRIGATION BRANCH

ROLL OF HONOUR

Employees Enlisted for Active Service

J. W. H. Wilkes	Leveller	Aug. 16, 1914	Lieut. 3rd Brig. R.H.A.
E. S. McMillan	Draughtsman	Aug. 21, 1914	L. Corp. Div'l Engineers
W. E. Dow	Draughtsman	Aug. 22, 1914	Bombing Instr. 13th M.D.
C. V. Craik	Engineer	Aug. 22, 1914	Corp. Div'l Engineers
E. S. Clifford	Hydro. Asst.	Aug. 24, 1914	Maj., Asst. Provost Marshal
R. V. Muller	Leveller	Aug. 26, 1914	Tpr. Royal Can. Dragoons
C. E. Vrooman	Leveller	Sept. 26, 1914	Spr. Div'l Engineers
C. P. Maxted*	Rodman	Sept. 26, 1914	Spr. Div'l Engineers
H. E. Bowden	Teamster	Sept. 26, 1914	Spr. Div'l Engineers
J. S. Ferrier	Draughtsman	Nov. 6, 1914	Lieut. Machine Gun Corps
H. D. St.A. Smith	Engineer	Nov. 9, 1914	Major Div'l Engineers
C. B. Hornby†	Accountant	Nov. 16, 1914	Capt. & Adj. 31st Battalion
G. N. Page	Leveller	Nov. 16, 1914	Pte. Army Service Corps
D. C. McDougall	Accountant	Nov. 19, 1914	Q.M.S. Div'l Engineers
G. H. Nettleton	Hydro. Asst.	Jan. 4, 1915	Lieut., Prov. Marshal's Staff
N. J. Arnold	Draughtsman	Jan. 28, 1915	Staff Sergt. 175th Batt.
H. S. Kerby	Engineer	Feb. 11, 1915	Lieut. R.N. Flying Corps
J. H. Jones	Engineer	Apr. 26, 1915	Capt. Div'l Engineers
E. W. W. Hughes	Engineer	May 8, 1915	Pte. 53rd Battalion
G. R. Elliott	Engineer	Aug. 16, 1915	Lieut. Signallers Can. Eng'rs
W. T. White†	Engineer	Aug. 16, 1915	Capt. 1st Pioneer Battalion
N. R. English‡	Rodman	Sept. 15, 1915	Pte. 4th Univ.Co.P.P.C.L.I.
H. W. Cheney	Engineer	Sept. 29, 1915	Lieut. 4th University Co.
W. E. Hunter	Accountant	Oct. 2, 1915	Sergt.-Major 87th Battalion
E. L. Hornby	Draughtsman	Oct. 12, 1915	Pte. 16th Batt. Can. Scottish
J. Cawthorn	Clerk	Oct. 14, 1915	Co. Q.M.S. 1st Pioneer Batt.
H.B. R. Thompson	Engineer	Nov. 8, 1915	Pte. 1st Pioneer Battalion
F. R. Burfield	Engineer	Dec. 31, 1915	2nd Lieut. Royal Engineers
W. G. Guthrie	Draughtsman	Feb. 20, 1916	Pte. Army Medical Corps
L. E. M. Shenton	Draughtsman	Feb. 24, 1916	Sergt. Australian Imp.Forces
W. B. Hutcheson	Engineer	Mar. 13, 1916	Lieut. Royal Flying Corps
H. R. Carscallen	Engineer	Mar. 31, 1916	Lieut. Div'l Engineers
W. R. McCaffrey	Engineer	Mar. 31, 1916	Sergt. Can. Reserve Cyclists
R. E. Matheson	Hydro. Asst.	Mar. 31, 1916	Spr. Div'l Engineers
P. J. Jennings	Office Engnr.	Apr. 1, 1916	Capt.& Adj.4th Pioneer Batt.
G. H. Whyte†	Engineer	Apr. 4, 1916	Lieut. Div'l Engineers
T. H. Burt	Hydro. Asst.	Apr. 4, 1916	Pte. Army Medical Corps
R. H. Goodchild	Engineer	Apr. 22, 1916	Lieut. 4th Pioneer Battalion
L. J. Gleeson	Engineer	May 9, 1916	Corp. 50th Queen's Battery
F. K. Beach	Engineer	May 21, 1916	Lieut. 8th Can. Ry. Con.Batt.
J. M. Paul‡	Engineer	May 22, 1916	Gunr. 72nd Queen's Battery
O. H. Hoover	Engineer	June 15, 1916	Gunr. 67th O.S. Battery
I. R. Strome	Engineer	June 20, 1916	Lieut. 25th Reserve Battalion
J. A. Currie	Draughtsman	Aug. 1, 1916	Gunr. 73rd Field Battery
G. C. McIntosh	Draughtsman	Aug. 19, 1916	Pte. Div'l Cyclists

*DIED OF WOUNDS

†KILLED IN ACTION

‡AWARDED MILITARY CROSS

‡DIED OF SICKNESS

A. C. Wimberley	Draughtsman	Sept. 1, 1916	Gunr. 72nd Battery
R. J. Srigley	Hydro. Asst.	Oct. 1, 1916	Pte. 187th Battalion
R. J. McGuinness	Engineer	Nov. 15, 1916	Pte. 239th Battalion
A. E. Hughes	Packer	Nov. , 1916	Pte. 211th Battalion
R. J. G. White	Chief Clerk	Dec. 1, 1916	Spr. Div'l Engineers
V. Meek	Engineer	Dec. 11, 1916	Lieut. Tunnelling Co.
T. M. Montague	Engineer	Dec. 11, 1916	Lieut. Tunnelling Co.
J. A. Telfer	Leveller	Jan. 1, 1917	Pte. Div'l Engineers
J. E. Caughey	Engineer	Mar. 1, 1917	Lieut. 78th Battery, C.F.A.
E. J. Switzer	Engineer	Mar. 12, 1917	Gunr. 38th Siege Battery
R. H. Waterhouse	Clerk	May 12, 1917	Pte. Can. Army Med. Corps

Employees Enlisted for Active Service

W. H. Wilkins	Leveller	Jan. 10, 1917	Gunr. 72nd Battery
W. H. Wilkins	Leveller	Jan. 10, 1917	Pte. 187th Battalion
W. H. Wilkins	Leveller	Jan. 10, 1917	Pte. 239th Battalion
W. H. Wilkins	Leveller	Jan. 10, 1917	Pte. 211th Battalion
W. H. Wilkins	Leveller	Jan. 10, 1917	Spr. Div'l Engineers
W. H. Wilkins	Leveller	Jan. 10, 1917	Lieut. Tunnelling Co.
W. H. Wilkins	Leveller	Jan. 10, 1917	Lieut. Tunnelling Co.
W. H. Wilkins	Leveller	Jan. 10, 1917	Pte. Div'l Engineers
W. H. Wilkins	Leveller	Jan. 10, 1917	Lieut. 78th Battery, C.F.A.
W. H. Wilkins	Leveller	Jan. 10, 1917	Gunr. 38th Siege Battery
W. H. Wilkins	Leveller	Jan. 10, 1917	Pte. Can. Army Med. Corps

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